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Over-Capacity

ONE of the patent evils in the industrial situation is over-capacity.

There is hardly a major industry that is not so over-equipped that it could, running at one hundred per cent capacity, much more than supply the normal demand.

The results are baleful in many ways.

In the first place the standing charges against the unused or little used equipment have to be carried by the output of the industry and paid eventually by the consumers of its products.

In his dread of monopoly and his delight in competition the buyer overlooks the fact that he is supporting two manufacturers instead of one; for if both survive, each must charge enough for his smaller product to pay a return on his investment as well as a profit on his turnover.

It would be better economics to let one or more manufacturers, with capacity only sufficient for the normal demand, do the whole job, running with a good load factor and with a stable organization confident of continuous employment.

A population needs a certain quantity of staple products, year in and year out, to maintain itself in health and comfort. If it purchases less than this, it is because it has not the means. If it purchases more, it is because it is oversold.

If it has not the means, it is because it is not gainfully employed. But the surplus personnel of an over-equipped industry cannot be gainfully employed all the time.

Hence, surges of shortage and overproduction, activity and idleness, prosperity and hard times.

If some superman owned the whole works, he would select enough of the more efficient and best situated plants to supply the normal demand and shut the rest down, as the Consolidation Coal Company has done in the over-developed bituminous field.

If all industries would do this, and if something less costly and disturbing than competition could be found to keep profits within bounds, employer and employed and the ultimate consumer, who after all belongs to one class or the other of these, would be better off.

F. R. Low

What Is the Measure of Power Service Performance?

SINCE the performance of a power house is measured in terms of the efficiency of the units and the economy of over-all operation, it too often happens that the same yardstick is applied to the power services. Unfortunately, this procedure does not give a true picture of effectiveness of power in production work. What is wanted is, rather, a means of judging whether or not the power services are of the kind and are applied so as to give the lowest cost of output possible in any particular industry.

The basis of such a measurement may be called relative utility. It can be obtained by reducing each step in the generation, transmission, and application of any power service to a common quantity, as cents per million B.t.u. By test and experience a determination of the minimum power cost in the same units, as represented in the cost of making the plant's finished product, can be determined. Measured against this, the cost of supplying power services in any of the various possible combinations, will give a means of determining what set-up to choose.

What Is Known of Fuel Oil?

THE efforts of the Diesel Engine Society and the American Society of Mechanical Engineers to construct a standard by which Diesel oil can be purchased are worthy of support by all interested in the buying and selling of fuel. An acceptable standard will not come out of the conference rooms in a day, for the subject is indeed broad; and the desires of the various interested parties do not by any means coincide. Furthermore, too little is known of the behavior of oil under the conditions existing within a hot cylinder.

For many years the Baumé gravity has been an important item in various fuel specifications. At present most authorities are agreed that gravity is of little importance, and that viscosity, or the flowability, of the oil should replace Baumé gravity.

Of course, an oil must be free-flowing at room temperature to insure the charging of the pumps without danger of gas pockets. The viscosity also largely predetermines the size of the atomizer openings and the spray pressure. By heating, any viscosity can be obtained; but the mere arrival at the desired viscosity does not insure that the oil will act identically with an oil that has the same viscosity at a lower temperature.

For example, some of the Borneo oils, when heated to give the correct viscosity for atomization, seem to burn satisfactorily. But inspection of an engine after a few weeks of operation on these oils will reveal a heavy coating of a dry asphalt deposit. In fact, one engine builder found that, after heating the oil to make it suitable for handling by the fuel pumps, it was necessary to cool it at the spray valve so that larger openings and a higher blast pressure could be used. Apparently, the oil breaks down into other combinations when injected at a high temperature.

It seems difficult, then, to use a viscosity stipulation save when the reading is obtained at room temperature; and if this temperature is used, many excellent heavy oils will be barred.

After all, the proof of the pudding is in the eating, which, in case of oil, might be taken to mean that oil from each particular field should be tested. This would not insure satisfaction, for adjacent wells may and do show remarkable variations in oil characteristics.

The difficulties to be overcome in arriving at a standard fuel are many, but their very number makes the advantages of a standard specification all the more obvious. With the proper spirit of give-and-take, the various committees can work out an acceptable solution.

Welding in the Power Plant

THE recent award of substantial prizes for papers on welding, by the A.S.M.E., should stimulate interest in the possible applications of welding in the power plant.

Welding is already widely used in power plants for sheet-metal work and may be considered standard practice for the construction of plate-type air preheaters, ducts, breechings, etc. In some plants piping is almost all welded in place of using flanged bolted joints. The new Gould Street Station in Baltimore has almost all piping welded except the main steam piping, which has Sargol joints.

It is said that there are over twenty-five buildings in the United States with welded steel frames. One can anticipate no serious difficulties in the use of welded structural-steel framing for power plants. Chimneys may be constructed cheaply of welded steel plates. Coal bunkers lend themselves to this manner of construction. Crane girders and carriages can also be welded together in place of riveting. The structural-steel supports of the main turbine generators can be made cheaper and of more pleasing appearance than when riveted.

Many large generator frames are already built of welded parts. Bedplates have been made of welded steel in place of cast iron. Condenser shells, now made of heavy cast iron, could be more cheaply made of welded steel plate. Heaters for all pressures can also be fabricated out of steel parts welded together.

In brief, welding has already reached a stage of development where much may be expected of it in the simplification of the construction and in the decrease of costs of new power plants.

First Register—Then Vote!

ELECTION day has come to be regarded by many, these last few years, as a good opportunity for the season's final golf game, fishing trip or motor outing. For this attitude there has been at least partial excuse, in that the issues at stake have not been such as to arouse the deep enthusiasm of the voters; nor has the outcome, as a general thing, been a matter of much doubt.

Even in Presidential years, though there has been much interest in such matters as the League of Nations and the World Court, the result of the election has been so sure that numbers of otherwise conscientious citizens have felt fully justified in remaining away from the polls. In those years it is not likely that, if all the eligible voters had done their duty, the final outcome would have been any different.

But the coming election is another matter. This year the issues, foreign relations, export trade, agricultural relief and prohibition, are enlisting intense partisanship for one side or the other. Both of the big party candidates are men of personal popularity, with large bodies of ardent advocates. And, for the first time since 1916,

the contest promises to be so close that the ballots of even a few voters will, in many states, serve to weigh the scales on one side or the other.

And there is another issue this year, more personal to *Power* readers and the whole engineering profession. Do you, or do you not, feel that engineering should take a place beside the legal and military professions as a source of raw material for Presidential candidates? Whatever you think on this subject, now is the time to register your opinion. Such another opportunity may not come for years.

In view, then, of these facts—the importance of the national issues before the general electorate, the closeness of the contest, and the special issue facing engineers—*Power* wants to urge that all its readers and friends do their full duty as citizens. Whatever the pleasures or alternate duties may be that tend to keep you away from the polls, this year forego them. If you must be away from home on business, on registration day or election day, it makes no difference. Arrangements can be made to have your vote counted. *Power* urges you to do your share—first register, then vote!

The Vulnerable Spots

RELIABILITY is a prime requisite of any piece of equipment. Unless a machine can be relied upon to be available for service when required, it has no place in modern power generation and application. No piece of power equipment can be counted on to give one hundred per cent service, but the present demands for continuity require a high degree of reliability, with spare equipment to supply the deficiency.

To make equipment more reliable, much can be accomplished by a study of the causes of failures. A knowledge of these facts allows the engineer to go intelligently about removing the causes of machine troubles in service and incorporating features in new designs to prevent breakdowns. The report of the Hydraulic Power Committee of the National Electric Light Association on the "Reliability of Hydro-Electric Units" is a good example of such studies. In this year's report eighty-six units are analyzed, which range in size from five thousand to fifty-two thousand horsepower.

From all causes these units were out of service twenty-two thousand hours. About sixty per cent of this outage time was due to the waterwheels and their auxiliaries. Twenty-one per cent is chargeable to general hydraulic causes outside the plant, and nineteen per cent was caused by the generators and their appurtenances. The percentages correspond closely with those given in the report of the previous year. From this it is apparent that the waterwheels and their auxiliaries are the chief cause of outage time in hydro-electric plants.

In the 1926 report thrust bearings, which carry the total weight of the revolving element, are charged with only 0.06 of one per cent of the outage time. This in actual time is less than twelve and one-half hours for the sixty-four vertical reaction-type units included in the report. This would indicate that this part of the equipment has been developed until it is as near one hundred per cent perfect as is possible. The guide bearings account for over three per cent of the outage time. These bearings are not subjected to loading in any way comparable to those on thrust bearings, but they are accountable for fifty-two times as much outage time.

The runner of a waterwheel is one of its vulnerable parts. In 1925 thirty-five per cent of the outage time of reaction-type units was chargeable to the runners, and in 1926 nearly nineteen per cent of the outage time was due to this part. The penstocks and canals are also the cause of an outage time of about ten per cent. These figures should not be taken to indicate that the hydro-electric unit is not reliable, since just the reverse is true, but they do point the way to where the vulnerable spots are and where the greatest possibilities of increasing the reliability and durability of the equipment lie.

Industry Interdependence and the Power Field

VIEW the broad field of industry. What characterizes it today that did not a decade ago? Nothing, perhaps, so much as knowledge of the interdependence of one industry upon another and action based upon this knowledge.

The finished products of one line are the raw materials of another. Good business in automotive manufacture means prosperity for a score or more contributing industries. Big activity in construction work means full dinner pails for workers in the supply and transportation fields. And so it goes. This has become an age of mutualized effort that almost realizes the socialists' dreams, though in another way and from a different angle.

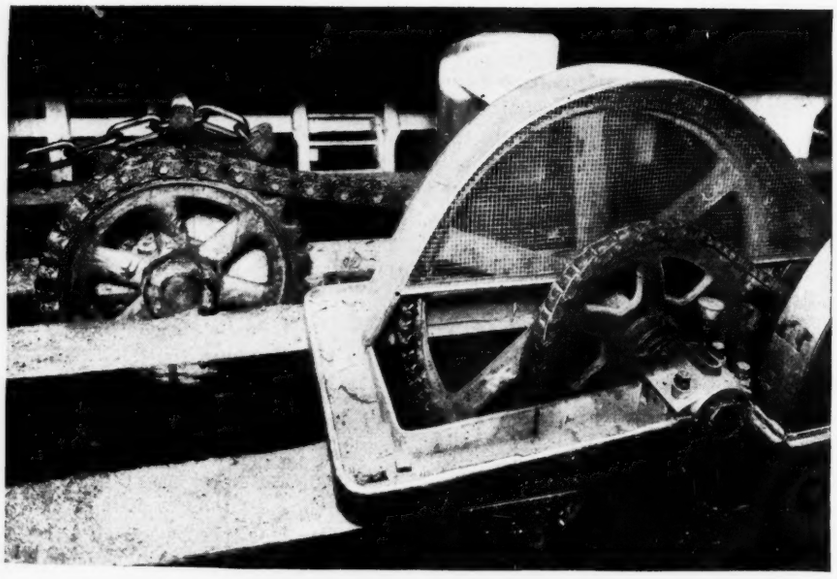
But what of the power field? Does it share in this general movement, in the economies and enhanced profits that have flowed from it; in the consequent greater prosperity for its workers? Unfortunately, it does not.

Power plants, in general, use but a small part of the heat in the fuel they burn, although in some favored industries this is not so. The rest of this heat is wasted in the condenser, up the stack or out with the exhaust. Heat—energy—is the principal product of this industry, but most of it is wasted. And the acknowledged high level of engineering ability available in the field is largely expending its efforts to increase the efficiency of the use, the economy of application, of that small portion of the heat that is not lost.

Here is the opportunity for co-operation, for interdependence, that spells increased prosperity for the power field. All around are heat-using industries that can economically use this otherwise wasted product. Heat in condenser water can be used in the concentration of salts, in leaching and extraction processes and a hundred other ways, many as yet unknown. Heat in waste gases, being of a higher temperature, can be used directly in processes such as drying, distillation and evaporation. Even the ash from the boilers can do useful work in giving up its sensible heat.

Of course, such co-operation will not be easy of attainment. Nothing worth while is. So much of the power industry has played a lone hand for so long that the large investment in present facilities and the whole tradition of the field make any change particularly difficult.

But the really important economies of the future must come from an increased utilization of the heat in the fuel, not from further refinements in existing methods. Such refinements are helpful and necessary, but they hold forth but small promise compared to the rewards that must follow more complete heat utilization. Let power engineers work for the day when heat becomes the primary product of the plant and electrical energy is one of the forms in which it is sold.



Chain drive on cast-steel sprockets driving main refuse conveyor in lumber mill

SELECTING CHAIN DRIVES

On Cast-Tooth Sprockets

By Charles R. Weiss
Chief Engineer
Ewart Plant, Link-Belt Company

OVER fifty years ago the first practical power transmission chain was invented by William D. Ewart. It consisted of malleable-iron link castings, which were assembled readily into continuous chains, and detachable at every link for lengthening or shortening. It was known as the Ewart detachable link-belt, being first applied to drives on agricultural implements, and afterward to general industrial drives.

Designers soon recognized that this chain afforded possibilities for a variety of uses outside of plain power transmission drives; and patterns were made for auxiliary forms of links, or attachments, to which elevator buckets, conveyor flights or cross-slats could be fastened, for handling materials vertically, horizontally or at an incline. Other attachments were designed to serve as pushers, carriers, etc., thus leading to the development of the present-day methods of handling products mechanically, in bulk or package, at great labor-saving efficiency and economy, compared with the former hand methods of doing this class of work.

As load and speed requirements increased, chain designers developed their art and improvements were made in the general styles of chain, methods of strengthening, reduction of friction by using rollers at the chain joints and substitution of steel pins for joining the links.

These improvements were followed by the construction of chains made entirely of steel, first using ordinary steels for all the parts; while later, various refinements were introduced to secure more accurate pitches, smoother bearing surfaces, and rollers and bushings with special finish and casehardening to reduce friction and wear.

Selecting the type and size of chain to use for a specific drive, figuring the pull or horsepower, choosing the sprockets and drive centers and determining the length of the chain are problems that have been complicated and tedious at best. These operations are simplified and a general summary of the subject given that should prove useful.

To meet increased demands for strengths, speeds and efficiencies in established and widely used sizes of chain, a more careful selection and analysis of materials for chain parts followed, with heat treatments, special alloys, closer clearances and greater accuracy in details of manufacture, accompanied by such refinements in the sprockets as cutting the

teeth in scientifically designed shape to furnish smoother action between chain and wheels, rollers being used at the chain joints to provide for greater ease of tooth action at the points of engagement and disengagement.

Rollers of relatively large diameters are frequently

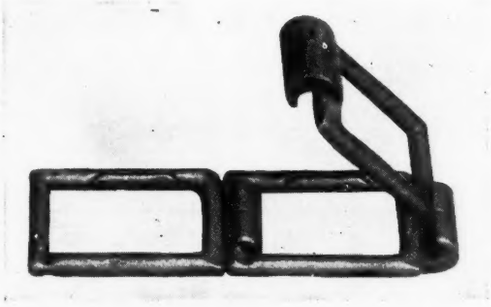


Fig. 1—Ewart detachable Link-Belt is suitable for speeds up to about 400-ft. per min.

This type is a reliable power transmission chain within the limits of its strength, but, as it has an open hook on each link, it should not be used where abrasive materials are likely to work into the joints.

used to provide a rolling feature for conveyor chains, and hence to reduce the frictional resistance, as it is well known that the rolling friction of a wheel on an axle is less than sliding friction.

While space will not permit reproducing here a mass of useful and recently published data on chain drives, in the following treatment are given some explanations as to terms used in the discussions, as well as some suggestions for the selection of suitable types, pitches and strengths of chains and diameters of wheels; and a tabulation of the important "safety factors" by which the advertised ultimate strengths of the chains, in pounds, should be divided, to determine what working strengths to assume for a given chain running on a wheel of given size at a given speed in feet per minute.

Selection of Types and Sizes of Chain

In general, the longer pitches of chains are used in conveyor and elevator work and the shorter pitches in power transmissions, although in the intermediate pitches, say two to four inches, the same chains are often used for either purpose, being furnished plain for drives or provided with attachments at necessary intervals for conveyors or elevators. In this article we are concerned particularly with drives and with the effects of speeds, pitches, strengths and details of construction of chain on the selection of types and sizes for the work in hand.

There are three general types of chain extensively used in drives employing cast-tooth wheels:

The Ewart detachable Link-Belt, Fig. 1, is a reliable power-transmission chain within the limits of its strengths, but as it has an open hook, it should not be used where abrasive material is likely to work into the joints. It is suitable for speeds up to approximately 400 ft. per minute.

Closed-end pintle chains, Fig. 2, using malleable-iron links connected by steel pins or rivets, furnish a higher range of strengths, better protected chain joints and more sturdy construction within desirable limits of pitch, outside dimensions and weights per foot. These also are suitable for speeds up to about 400 ft. per minute.

Bushed steel-roller chains, Fig. 3, with hardened bearing surfaces and rollers, are made in a large variety of sizes and pitches, furnishing still greater strengths and durability for economical operation at speeds up to about 600 ft. per minute.

Chains are listed in various trade catalogs with their average ultimate breaking strengths as a basis of comparison and application. The allowances to be made in determining safe working strengths in general use are usually taken care of by dividing the ultimate strengths by safety factors. These factors vary with the types of chains, the speeds in feet per minute, the number of teeth in the wheels and other features affecting ultimate durability and satisfactory daily service.

Important items entering into the determination of safety factors in chains are: Internal wear in the joints; external wear from contact with teeth and rim of wheel under strain, and injury from shock or impact at different chain speeds.

For instance, so far as shock alone is concerned, the impact of a link traveling only 100 ft. per min. is 36 times as great on an 8-tooth wheel as on a 50-tooth wheel. The angle of articulation and amount of internal joint

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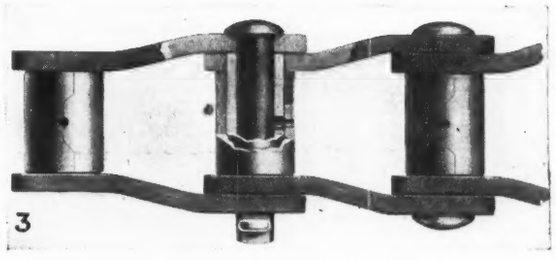

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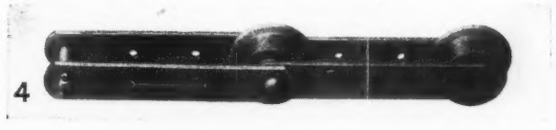

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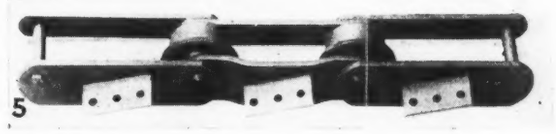

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Fig. 2—Closed-end pintle chain, using malleable-iron links connected by steel pins or rivets is suitable for speeds up to 400-ft. per min. and is of a more sturdy construction than Fig. 1

Fig. 3—Bushed steel-roller chain with hardened bearing surfaces and rollers, has greater strength and durability than Fig. 2, and can be used for speeds up to 600-ft. per min.

Figs. 4 and 5—Types of steel chain with rollers for conveyor service

wear naturally would be much greater where there are few teeth than where there are many.

The destructive combination of high chain speed with small diameter of wheel is seen from the accompanying table of working factors, where it will be noticed that

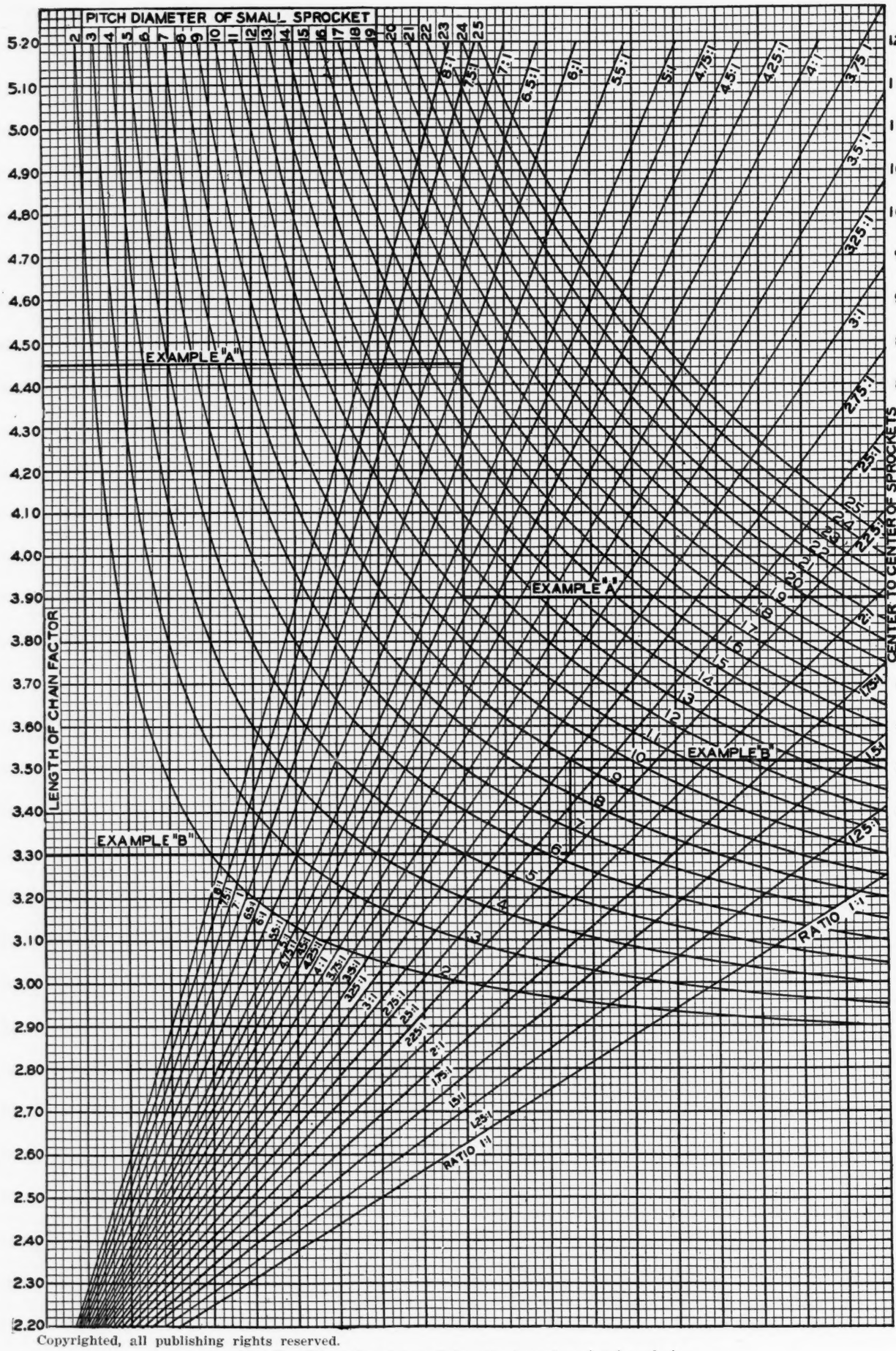

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Fig. 7—Chart for determining the lengths of drive chains

at 100 ft. per min. the factor for a malleable-iron chain running over a 50-tooth wheel is 5, and over a 10-tooth wheel it is 5.9; whereas at 500 ft. per min. it is 20.6 over a 10-tooth wheel. In other words, a chain more than three times as strong should be chosen to stand the strains, shock and wear that result from high speed over a small wheel; even though, outside of these considerations, a given number of pounds of pull theoretically would produce five times the horsepower at 500 ft. per min. that it does at 100 ft. per minute.

In the accompanying working-factor table the Ewart detachable Link-Belt and the closed-end pintle chains mentioned previously are grouped as malleable-iron (M.I.) chains running on cast-tooth wheels, under similar operating conditions; while the bushed steel roller chains are grouped as "SS" class chains, whose advantages of rollers to ease them on and off the wheels and hardened pins and bushings to resist internal joint wear make unnecessary such large allowances for wear and such limits of speed as are required for the malleable-iron chain's rigid contacts with teeth and rims of wheels and the less protected bearing surfaces in the chain joints. For instance, the "M.I." factor for a 10-tooth wheel is 15.4, while the "SS" factor is only 10, at a chain speed of 400 ft. per minute.

How to Apply Working Factor

To show how to apply the working factors given in the table to the selecting of a chain, take as an example a malleable-iron chain having 6,000 lb. ultimate strength to operate at a speed of 300 ft. per min., when running over a twelve-tooth sprocket. Find the horsepower that can be safely delivered.

$$Hp. = \frac{Breaking\ strength\ (6{,}000) \times speed\ (300)}{Working\ factor\ (10.2) \times 33{,}000} = 5.3$$

In the lower speeds the malleable-iron chains are efficient, and may be used advantageously, while for the higher speeds the advantages of greater strength for their weight and the use of rollers and bushings for reduction of wear, both on chains and wheels, make the steel chains more desirable, because of the smaller safety factors required and the greater range of strengths offered.

Data presented in this article refer only to drives using cast-tooth sprockets. For higher speeds it is advisable to use the more highly refined steel-roller chains, with cut-tooth sprockets, or else the silent chain drives, these latter being especially suitable for transmissions direct from motors or other high-speed shafts.

Selection of Sprockets

When the smaller sprocket is the driver, use not less than 12 teeth, if possible.

When the smaller sprocket is the driven, use more than 12 teeth, if possible.

Where the r.p.m. of driver and driven shafts are the same, use at least 17 teeth, if possible, in the sprockets.

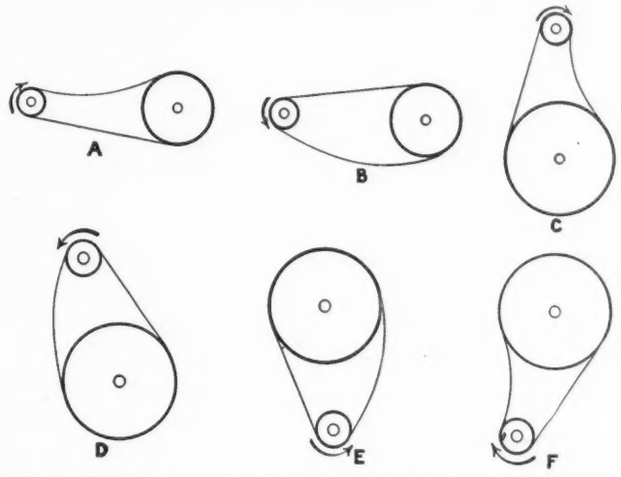

Fig. 6—Diagrammatic layouts showing relative positions of sprockets

Arrangements *A*, *B*, *C* and *D* show good practice. When the center of the large sprocket is directly over that of the small one, as in *E*, the drive cannot be run with much slack in the chain. If the drive can be inclined, as in *F*, it will require less care and adjustment.

The number of teeth for the large sprockets should not exceed 60.

The general formula for relations of the four factors in a drive, is:

R.p.m. of driver × *No. of teeth of driver* = *r.p.m. of driven* × *No. of teeth of driven*

Having any three of these factors, the fourth is easily determined from the formula in the usual manner.

Where the speeds for both shafts are known but neither sprocket is selected, the r.p.m. of the higher-speed shaft, divided by that of the lower-speed shaft, gives the ratio. Determine the number of teeth needed for the wheel on the high-speed shaft by deciding what small wheel and chain will meet the horsepower requirements, and multiply this number of teeth by the ratio, to get the number of teeth for the large sprocket on the slow-speed shaft.

The center distance should be at least equal to the pitch diameter of the larger sprocket, plus one-half the pitch diameter of the smaller sprocket. Some drives of necessity must be operated on shorter centers, but it should be remembered that this reduces the contact between the chain and the teeth of the smaller sprocket, resulting in shorter chain life. Avoid drives of extremely short or long centers.

Chain drives on cast-tooth sprockets will

WORKING FACTORS FOR MALLEABLE-IRON AND BUSHED STEEL-ROLLER CHAINS

Number of Teeth	Chain Speed in Feet per Minute													
	50 and 100		150		200		300		400		500		600	700
	M.I. Chains	SS. Chains	M.I.	SS.	M.I.	SS.	M.I.	SS.	M.I.	SS.	M.I.	SS.	SS.	SS.
10	5.9	5.9	6.7	6.5	7.5	7.0	11.0	8.0	15.4	10.0	20.6	12.0	14.0	17.0
11	5.7	5.7	6.5	6.3	7.3	6.8	10.5	7.6	14.9	9.7	19.6	11.4	13.0	15.8
12	5.6	5.6	6.3	6.1	7.1	6.8	10.2	7.4	14.4	9.4	18.8	10.9	12.2	14 8
13	5.5	5.5	6.2	6.0	7.0	6.5	10.0	7.3	14.0	9.1	18.2	10.6	11.6	13.9
14	5.4	5.4	6.1	5.9	6.9	6.4	9.8	7.1	13.7	8.9	17.7	10.3	11.1	13.1
15	5.3	5.3	6.0	5.8	6.8	6.3	9.5	6.9	13.4	8.7	17.2	10.0	10.8	12.3
16	5.3	5.3	5.9	5.7	6.6	6.1	9.3	6.8	13.2	8.6	16.8	9.8	10.5	11.9
17	5.3	5.3	5.9	5.7	6.6	6.1	9.2	6.7	12.9	8.4	16.4	9.5	10.3	11.5
18	5.3	5.3	5.8	5.6	6.5	6.1	9.1	6.6	12.7	8.3	16.0	9.3	10.1	11.2
19	5.3	5.3	5.8	5.6	6.5	6.1	9.0	6.5	12.5	8.1	15.8	9.2	9.9	11.0
20	5.3	5.3	5.8	5.6	6.5	6.1	9.0	6.5	12.3	8.0	15.6	9.1	9.7	10.8
21	5.3	5.3	5.8	5.6	6.5	6.1	8.9	6.5	12.2	7.9	15.3	8.9	9.6	10.7
22	5.3	5.3	5.8	5.6	6.4	6.0	8.9	6.5	12.1	7.9	15.2	8.8	9.5	10.6
23	5.3	5.3	5.8	5.6	6.4	6.0	8.8	6.4	12.0	7.8	15.0	8.7	9.4	10.5
24	5.3	5.3	5.8	5.6	6.4	6.0	8.7	6.3	11.9	7.8	14.8	8.6	9.3	10.4
25	5.3	5.3	5.8	5.6	6.4	6.0	8.7	6.3	11.8	7.7	14.7	8.5	9.2	10.2
30	5.2	5.2	5.7	5.5	6.3	5.9	8.5	6.2	11.5	7.5	14.0	8.1	8.9	9.8
35	5.2	5.2	5.7	5.5	6.2	5.8	8.4	6.1	11.2	7.3	13.5	7.8	8 5	9.5
40	5.1	5.1	5.6	5.4	6.1	5.7	8.2	6.0	10.8	7.0	13.0	7.6	8.3	9.2
45	5.1	5.1	5.6	5.4	6.1	5.7	8.1	5.9	10.4	6.8	12.5	7.3	8.0	9.0
50	5.0	5.0	5.5	5.3	6.0	5.6	8.0	5.8	10.0	6.5	12.0	7.0	7.8	8.8
60	4.9	4.9	5.4	5.2	5.9	5.5	7.8	5.7	9.4	6.1	11.0	6.4	7.3	8.2

M.I. = Malleable Iron. SS. = Bushed Steel-Roller.

operate satisfactorily with almost any ratio and relative position of sprockets, and with the slack on either the upper or the lower side. In Fig. 6 the drawings *A, B, C* and *D* show good practice. When the center of the large sprocket is directly over that of the smaller, as in *E*, the drive cannot run with much slack in the chain. As a chain elongates with wear, it will be necessary to make frequent adjustments of the center distance, or use an adjustable idler on the back of the chain, to take out the slack and preserve proper contact of the chain with the small sprocket. If this drive can be slightly inclined, as in *F*, it will require less care and adjustment.

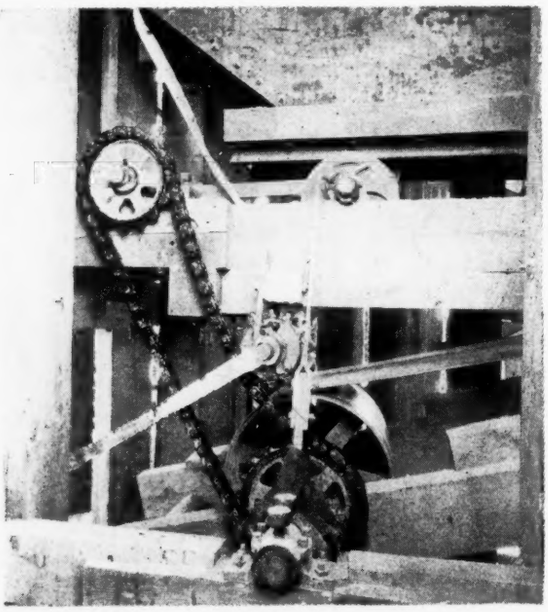

Fig. 8—Heavy-type reciprocating feeder in rock plant driven by bushed steel-roller chain through cast-steel jaw clutch

With horizontal drives having small sprockets it is preferable to have the slack on the bottom rather than on the top, for if the slack is allowed to accumulate, the chain is damaged by striking one strand against the other.

In horizontal or inclined drives with short centers, the slack should be on the bottom, as an accumulation of slack on top causes the chain to pinch between the sprockets.

Figuring from formulas the length required for a belt to go around pulleys, at a given center distance apart, is somewhat complicated and tedious at best. Usual computations for determining the length of a chain to go around sprockets add the complication of fractional expressions of chain pitches and pitch diameters of sprockets. These and other factors were taken care of in the computations from which the relations of curved and straight lines in the chart, Fig. 7, were laid out. It is only necessary, therefore, to follow through the chart and then multiply the ascertained "length of chain factor" by the center distance, in inches, between sprockets, to obtain a sufficiently close approximation to the total length of chain for practical purposes.

Intermediate figures between those shown, can be interpolated proportionately by eye. The curved lines start with even inches of pitch diameter of the small wheel, at the top. The diagonal lines, for the ratio of the teeth of the wheels, are laid out for the nearest quarter of whole numbers from 1 up to 8. The center distances of the wheels are laid out in even inches at the right, up to 120 in.; and the "length of chain factors" at the left, with a line for each 0.02 in the factor.

To use the chart, enter at the right at the given center distance, moving to the left on the horizontal line to the intersection with the curved line that shows the pitch diameter of the smaller wheel. From this intersection move up or down to the intersection of this vertical line with the diagonal that shows the ratio of the teeth of the wheels, then left horizontally to the "length of chain factor." Multiply this factor by the shaft center distance, to obtain the total length of the chain.

When the calculation results in a fraction of a chain pitch, add enough to make a full pitch. A straight-side-bar steel chain should, if possible, be used with an even number of links, so that the ends will couple together naturally. If an odd number of links is necessary for such a chain, an offset coupler should be used, to avoid having too much slack in the chain. In any event it is desirable to provide, in the case of a chain with straight side bars, an offset coupling link for use when needed; for instance, when the chain has stretched and become slack from wear.

In example A, Fig. 7, the sprocket centers are 55 in. apart, the small sprocket is 11 in. in diameter, and the ratio of the number of teeth in the large sprocket to the number of teeth in small sprocket is 6 to 1. To solve this problem on the chart, Fig. 7, start on the right with center distance 55 in.; run left to intersection with the curve for 11-in. sprocket; then vertically to the intersection with the 6 to 1 ratio diagonal line; then left to length of chain factor, as indicated by the heavy line example A. This gives a length of chain factor 4.45. Multiplying the center distance, 55, by the length of chain factor, 4.45, gives a total length of chain of 244.75 inches.

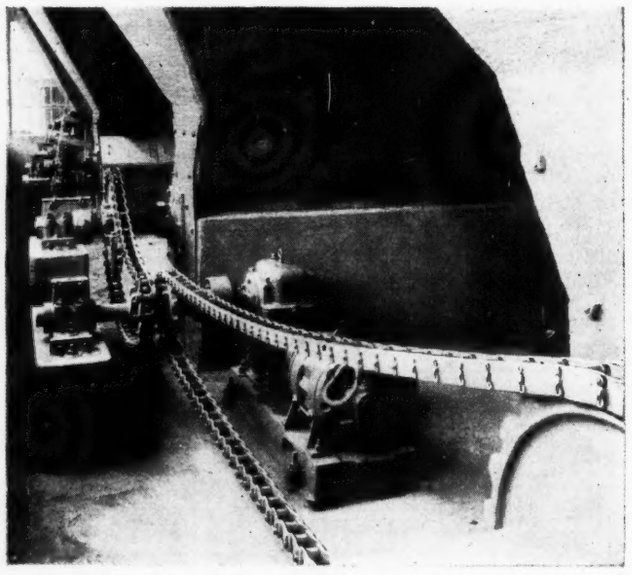

Fig. 9—Bushed steel-roller chain driving a screw conveyor in cement plant

Example B—With the center distance 36 in., the pitch diameter of small wheel 9 in., and the sprocket-tooth ratio 2.25 to 1, the chain factor is 3.30, which, multiplied by 36, gives the length of chain as 118.8 inches.

If the chain were of two-inch pitch, it would need to be 123 links long for example A and 60 links long for example B.

Condenser Leakage

Its Detection and Effect on Boiler Water Concentrations

By W. C. Carmichael

MOST large generating stations are equipped with surface condensers where an adequate supply of cooling water is had. Those not near enough to a large body of flowing water have cooling towers or spray ponds from which source is supplied the cooling water for the condenser.

The stations near to flowing water are usually supplied by river water or sea water, and thus no concentration takes place in the cooling water, as is the case where spray ponds or cooling towers are used. With a spray pond or cooling tower the circulating water from the surface condenser is sprayed into the air above the pond, and owing to the evaporation of the particles of water a certain concentration takes place.

Where no means of detecting condenser leakage is available, it eventually shows up owing to an excess of feed water, scaling of the boilers, and where sea water is used for cooling, corrosion is found.

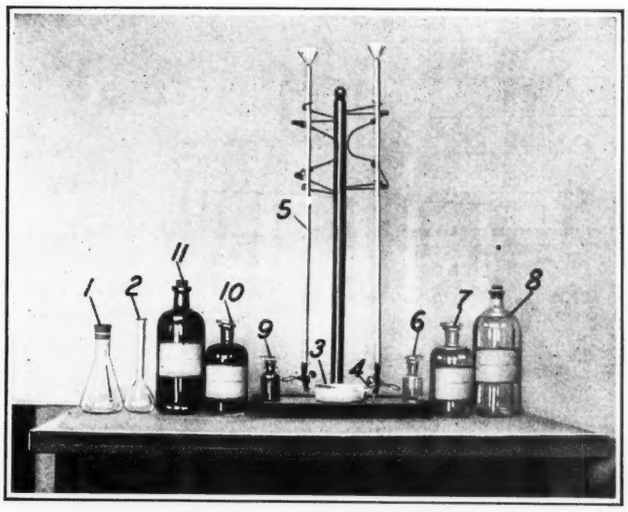

Fig. 1—Apparatus used in titration test

1. Sampling flask. 2. 100 c.c. measuring flask. 3. Porcelain titrating dish. 4. Glass stirring rod. 5. Burette. 6. Dropper bottle with phenolphthalein indicator solution. 7. Phenolphthalein solution. 8. Standard N/25 (normal twenty-fifth) sulphuric acid for titrating. 9. Dropper bottle with potassium chromate solution. 10. Potassium chromate solution. 11. Silver-nitrate solution.

The most common methods for the detection of this leakage is through the use of conductivity meters or by titration of the condensate with silver nitrate. The latter is applicable where salt water is used for cooling, as a small amount of salt will form a cloudy white precipitate when silver nitrate is added. To find the exact amount of leakage the silver nitrate should be made up to a definite standard.

The titration test of the condensate is commonly known as the salt test, as it implies, namely, a means for determining the amount of sodium chloride, or perhaps, chlorides of magnesium or calcium. The apparatus used to carry out this test is pictured in Fig. 1 and consists of two burettes, a white porcelain dish, the necessary indicators—phenolphthalein (5 grams

Directions for Neutralization of Soda Present and Salt Tests

1. Measure out 100 c.c. of condensate.

2. Pour into porcelain dish and add 5 drops of phenolphthalein indicator. This will turn the water pink if it contains soda ash, caustic soda or trisodium phosphate. Failure to turn pink indicates none of the above chemicals in solution.

3. Fill burette to zero mark with twenty-fifth normal surphuric acid.

4. Gradually add (titrate) the acid to the water until pink color starts to fade out. Continue adding until the faint pink color entirely disappears.

5. To the same sample of water add 5 drops of potassium chromate indicator. This will turn the water yellow.

6. Fill second burette to zero mark with standard silver nitrate.

7. Add (titrate) silver nitrate slowly from burette. Approaching the end point, a red color will appear and then disappear with each addition of silver nitrate. Continue titration until this red color just remains permanent, giving the sample a faint brownish-red tinge. This is the end point and the c.c. of silver nitrate used represents the grains per gallon of salt in the condensate, when the original sample of condensate was 100 c.c.

per liter of alcohol), and potassium chromate (50 grams per liter of distilled water), and the titrating agents—one-twenty-fifth normal sulphuric acid and standard silver nitrate (5 grams per liter of distilled water). These tests are covered in steps 1, 2, 3, 4, 5, 6 and 7 of the directions here given.

As most makeup water for boiler feed is treated with a soda, such as caustic soda, soda ash or tri-sodium

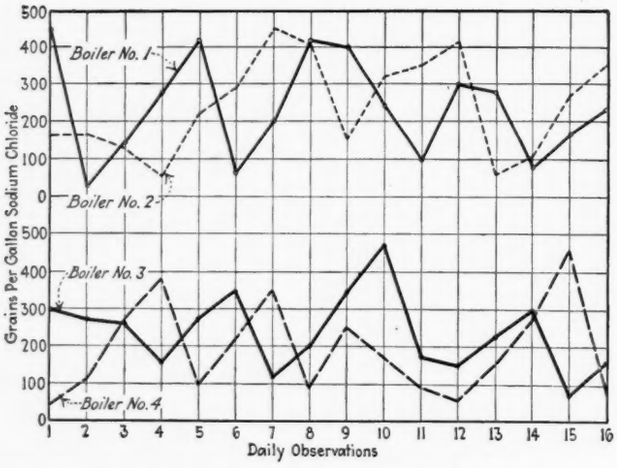

Fig. 2—Here are indicated the lowering of concentrations and the intervals between maximum concentrations

phosphate, there is a possibility that a small amount of this soda may be carried over with the steam from the concentrated boiler water and thus be present in the condensate. If such is the case, the soda should be neutralized with the sulphuric acid, as is explained in steps 2, 3 and 4, before proceeding with the salt test. In step 2, if the water does not turn pink, it is not necessary to add the twenty-fifth normal sulphuric acid, as in steps 3 and 4.

When very accurate results as to the salt content of the condensate are required, a salt test should also be made on a sample of live steam condensed, which is collected from the main steam line just preceding the turbine. This test is made in the same manner as the test on the condensate, using the same procedure when soda is present. For example, if the condensed steam showed 0.6 grain of salt per gallon and the condensate 2.5 grains, the actual amount of salt due to leakage would be the difference between 2.5 and 0.6, or 1.9 grains. When the salt content of the condensate is the same or less than that of the condensed steam, no leakage is indicated. However, when the condensate salt content is less than that of the condensed steam, the operator may look for turbine blade deposits, for otherwise the salt content of both samples would be approximately the same.

Effect of Boiler Water Concentrations

The effect that condenser leakage may have on boiler water concentrations depends on the source of the cooling water, whether fresh water or from a brackish stream, and also upon the amount of cooling water gaining entrance into the condensate.

In an investigation which the writer made, the effect of high salt concentrations was saliently pointed out. This plant was equipped with four turbines, one being surface condensing and the others having jet condensers; four boilers—two Babcock & Wilcox cross-drum, 5,500 sq.ft. each, and two Edge Moor cross-drum 6,000 sq.ft. each; and an open heater. The first effect of high boiler water concentrations noticed was a severe priming condition, which carried over sludge and lodged in the strainer of

TABLE I—ANALYSES OF MAKEUP WATERS FOR BOILERS

	Spring Water (Grains per U. S. Gal.)	City Water (Grains per U. S. Gal.)
Calcium carbonate	8.4	0.2
Calcium sulphate	2.6	Nil
Magnesium carbonate	Nil	0.5
Magnesium sulphate	2.1	2.6
Sodium sulphate	0.8	4.4
Sodium chloride	4.0	17.0
Silica	0.1	0.3
Iron and alumina	0.3	0.4
Total solids	18.5	25.7

TABLE II—ANALYSIS OF BOILER WATER AND RIVER WATER (COOLING WATER)

Boiler Water		River Water	
	(Grains per U. S. Gal.)		
Sodium chloride	29.9	Temporary hardness	1.7
Sodium sulphate	464.0	Permanent hardness	48.5
Sodium carbonate	1.7	Chlorides as sodium chloride	305.0
		Sulphates as sodium sulphate	39.3

the 600-kw. turbine. In order to clean the strainer, this turbine was taken off the line and two of the smaller turbines, having jet condensers, were placed in operation. This necessitated using 100 per cent makeup water, which rapidly increased the boiler water concentrations.

Analyzing the Makeup Water

The makeup was spring and city water. City pressure floated on the heater at all times, and what the spring was not able to supply was taken from the city supply. The analysis of both the spring and city water, as well

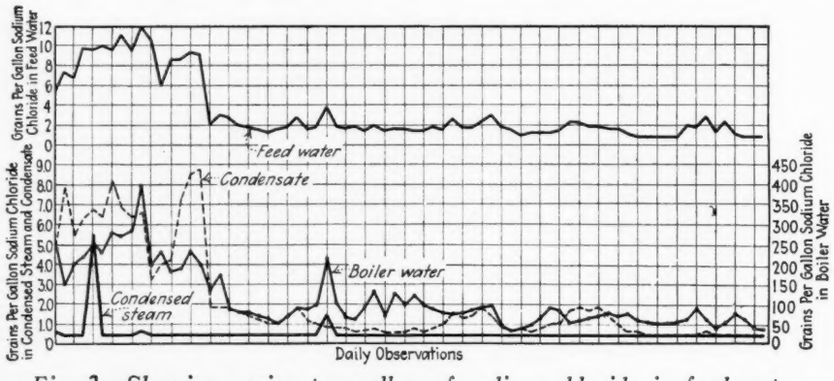
Grains Per Gallon Sodium Chloride in Feed Water
Feed water
Condensate
Boiler water
Condensed steam
Grains Per Gallon Sodium Chloride in Condensed Steam and Condensate
Grains Per Gallon Sodium Chloride in Boiler Water
Daily Observations

Fig. 3—Showing grains per gallon of sodium chloride in feed water, condensate, condensed steam and boiler water

as river water (cooling supply) is given in Tables I and II, also an analysis of boiler water, the samples of which was collected at the same period as the city and spring water. As may be observed, both the spring and city water contained an appreciable amount of magnesium sulphate and sodium chloride, which, in the presence of heat and pressure, is corrosive. The source of both these constituents was brackish water. The city supply, being partly river water, was affected by the rise and fall of tides, and the spring was supplied largely by seepage from the same river.

The writer arrived at the plant the day after the 6,000-kw. turbine had been put back on the line. As this turbine was surface condensing, tests were made on snap samples of condensed steam, condensate and boiler water.

The condensed steam was collected from the steam line supplying the turbine, the condensate from the discharge line of the condensate pump, and the boiler water from the blowoff line.

The first day's tests were as follows:

	Gr. Sod. Chlorid
Condensate	8.2
Condensed steam	0.8
Boiler No. 1	256.0
Boiler No. 2	238.0
Boiler No. 3	156.0
Boiler No. 4	200.0

In collecting all samples of boiler water, the feed valve was closed for a short interval before collection, thus insuring that the samples were not contaminated by any incoming feed water.

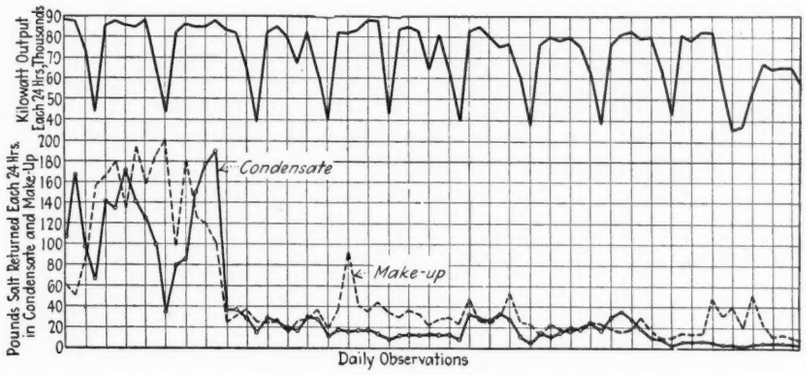
Kilowatt Output Each 24 Hrs, Thousands
Pounds Salt Returned Each 24 Hrs. in Condensate and Make-Up
Condensate
Make-up
Daily Observations

Fig. 4—Pounds of salt returned and kilowatt-hour output

The second day's tests were:

Morning Test

	Gr. Sod. Chloride	
Condensate	4.2	Collected at 11:10 a.m.
Boiler No. 1	356.0	Collected at 9:30 a.m.
Boiler No. 2	432.0	
Boiler No. 3	306.0	
Boiler No. 4	518.0	

Afternoon Test

	Gr. Sod. Chloride	
Condensate	6.2	Collected from 11:15 a.m. to 2:15 p.m.
Condensed steam	1.0	Collected at 2:10 p.m.
Boiler No. 1	338.0	Collected at 1:20 p.m.
Boiler No. 2	616.0	
Boiler No. 3	314.0	
Boiler No. 4	326.0	

The third day's tests were:

	Gr. Sod. Chloride	
Condensate	7.6	Collected from 4:40 p.m. to midnight.
Condensed steam	1.2	Collected from 4:30 p m to midnight
Boiler No. 1	448.0	Collected at 9:25 a.m.
Boiler No. 2	510.0	
Boiler No. 3	469.0	
Boiler No. 4	546.0	

As may be observed, the condensate showed a radical change from day to day on the different tests. This was not due to any noticeable increase or decrease in the amount of condenser leakage, but was caused by the difference in the tide of the river which supplied the cooling water. At the time of the different tests, the river water was as follows:

	Grains Salt
First day's test—high tide	384.0
Second day's test—low tide, morning test	200.0
Second day's test—high tide, afternoon test	392.0
Third day's test—high tide	386.0

By comparing the content of salt in the cooling water at the different tests and the condensate at the same time, the direct effect of the tide on the salt content in the condensate is seen.

In order to keep the sodium chloride content of the boilers below the priming concentration, the high reading boilers were blown down heavily at night. This lowering of concentrations and the time intervening until the maximum concentration was had, is plotted in Fig. 2.

Fig. 3 shows the grains per gallon of sodium chloride in the boiler water, condensed steam, condensate and feed water. The sudden drop of the sodium chloride content of the feed water, condensate, boiler water and condensed steam after about one-quarter of the chart, was due to the repairing of the leaky tubes of the surface condenser. The sodium chloride in the boiler water is the average of the boilers steaming for that day, which, in most cases, was much lower than the maximum concentration. The content of sodium chloride in the condensed steam and condensate was obtained by titrating 24-hour bleeder samples, which thus gave an average condition. In collecting the feed water, 24-hour samples leaving the open heater were taken, which included the makeup as well as the condensate returns.

In Fig. 4 is shown the pounds of salt returned each 24 hours in the condensate and feed water, as well as the kilowatt-hours output for the same period. It is of interest to note the general trend of the curve showing the amount of salt returned in the condensate as compared to the kilowatt output. This comparison indicates the effect of the turbine load on the amount of condensate returned, which in turn has a direct bearing on the amount of cooling water, or leakage, in the condenser. The same drop in Fig. 4 may be noticed as in Fig. 3, which was also due to repairing the condenser tubes and thus stopping the leakage. A treatment of caustic soda was now advised, basing the amount fed on the salt content per 100,000 lb. of water evaporated. As the total water fed to the boilers differed each day, the operator was then able to calculate the necessary amount of caustic soda used. The formula for calculating the amount of caustic used daily was as follows:

$$\frac{\text{Total water evaporated}}{100{,}000} \times \text{salt in feed supply} \times \text{rate of caustic soda.}$$

For example,

The total amount of water evaporated was 1,745,000 lb.

Salt in feed supply, 0.6 gr.

Rate of caustic soda per grain of salt in each 100,000 lb. of water, 0.8 lb.

$$\text{Total caustic to be fed, } \frac{1{,}745{,}000}{100{,}000} \times 0.6 \times 0.8 = 8.5 \text{ lb.}$$

The reason for using the salt content of the feed water and not of the condensate as a basis for treatment was that the feed water included both the makeup and the condensate returns. In Fig. 4 the pounds of salt returned each 24 hours in the condensate and feed water was calculated as follows:

Kw.-hr. output × water rate of turbine = lb. ÷ 8.3 = gal. condensate;

(Gal. condensate × gr. salt in condensate) ÷ 7,000 = lb. salt entering boilers due to leakage;

Gal. water evaporated × salt in feed supply = total salt entering boilers;

Difference between total salt and that due to condenser leakage = salt in makeup.

The corrosive and scaling effect of leakage, when the cooling water is contaminated by sea water, is shown

in Table III. Corrosion due to the presence of sea water is caused by the magnesium chloride and magnesium sulphate; the scaling effect by calcium sulphate. Some estimate can be had of the percentage of sea water in the river water as shown in Table II, by the following analysis of sea water: Silica, 0.24 grain per gal.; iron oxide, 0.15; calcium sulphate, 101.20; calcium carbonate, 8.75; magnesium chloride, 239.02; magnesium bromide, 20.24; potassium chloride, 55.30; sodium chloride,

TABLE III—ANALYSIS OF DEPOSITS FROM DIFFERENT LOCATION IN PLANT HAVING CONDENSER LEAKAGE

Feed Line Deposit	Per Cent	Tube Scale	Per Cent	Drum Scale	Per Cent
Silica	2.28	Si ica	Nil	Silica	4.21
*Iron oxide	90.31	*Iron and alumina	11.10	*Iron and alumina	36.52
Calcium carbonate	7.29	Magnesium silicate	9.00	Calcium silicate	4.03
		Magnesium hydrate	19.00	Magnesium silicate	21.80
		Calcium sulphate	55.00	Calcium sulphate	4.67
		Organic matter	5.90	Organic matter	28.72

* Note high content of iron in feed line deposit and drum scale, also tube scale

1,928.27 grains per gallon. By comparing the sodium chloride, or salt, content of sea water with the salt content of the river water, the approximate percentage of sea water present may be seen.

The corrosive effect of magnesium chloride is very active in the presence of heat on account of the dissociation of the salt (magnesium chloride) into magnesium hydrate and hydrochloric acid. The chemical reaction for this is as follows:

$$MgCl_2 + 2H_2O = Mg(OH)_2 + 2HCl$$

The acid attacks the iron and forms ferrous chloride with the liberation of hydrogen:

$$2HCl + Fe = FeCL_2 + H_2$$

A corrosive cycle is then established by the reaction of the ferrous chloride with the original magnesium hydrate, thus producing more magnesium chloride:

$$FeCl_2 + Mg(OH)_2 = MgCl_2 + Fe(OH)_2$$

Magnesium sulphate itself does not have the same corrosive effect as magnesium chloride, but can become exceedingly active in the presence of sodium chloride, due to the forming of magnesium chloride:

$$MgSO_4 + 2NaCL = MgCl_2 + Na_2SO_4$$

Corrosion that results from the breaking up of magnesium salts is serious on account of the extensive

TABLE IV—ANALYSIS OF BOILER SCALE SHOWING EFFECT OF CONDENSER LEAKAGE FROM SPRAY POND

Tube Scale

	Per Cent
Silica	7.32
Iron and alumina	14.00
Calcium and magnesium as calcium carbonate	77.79
Calcium sulphate	0.89

destruction that can take place before the corrosion is discovered. Since all corrosion within boilers caused by the action of high temperatures and pressures is covered with scale deposits, and as these salts are associated with soluble matter causing scale alone, a chemical treatment for the total precipitation of all scale-forming salts from the water within the boiler is the only positive action to take against it.

Leakage from the cooling water taken from a spray pond is usually less serious compared to sea-water leakage. The makeup supply for most spray ponds is water which contains scale-forming, instead of corrosive constituents. Table IV gives a scale analysis from a plant experiencing a slight amount of leakage. The scale was soft and of a sludgy nature, which was easily removed.

The majority of turbine plants have surface condensers and are equipped with evaporators or external softeners. Any condenser leakage had mixes with the condensate and is therefore not treated as is the makeup water. For this reason alone, precautions should be used for determining any leakage, as a very small amount may cause serious trouble, from either a scaling or corrosion point of view.

Employees' Vacation as an Asset

By William S. Hobbs
Homestead, Fla.

While summer vacations are given to salaried employees in most of the Northern industries, the practice is not so general in the West and South.

Conditions for the men that work have improved in America considerably in the last 50 years, and vastly over the laborers' present condition in Europe, but even so, there are in our economic scheme many elements that are producing decided social unrest.

Enjoying the privilege of a two weeks' vacation may seem to some far removed from economic problems, but let us consider. Labor Bureau statistics show that this country has been averaging 3,343 strikes a year. This is surely evidence that there is much to be desired in bettering the workingman's condition. Long hours and poor pay were not the only reasons for the comparatively recent coal strike in England, according to an eminent labor leader from that country—lack of any leisure time or energy after working hours entered materially into the question.

Work is made practically the only factor in a man's life when you multiply ten hour a day by 365. Far too many men work Sundays in addition to their long hours during the week, and these Sundays count up to 52 days a year. The problem of arranging schedules so that Sunday work shall be at a minimum is a subject in itself, but there are sound practical reasons for the Biblical injunction against work on the seventh day.

These long hours every day in the year leave little time and no energy for culture or recreation. Such a condition is stultifying. And the man needs two weeks each year to get away from it all, to seek new interests, to revive old friendships, to rest, or to take a trip and see something different.

Poor judgment is shown by the employer who "tightens down" on the worker because he has the power to do so. Such action on the part of an employer is selfishness and oppression, and the individual or company that cannot exist except by adopting such petty methods of saving dollars has no right to existence. He is sacrificing the workers' well being to an apparent material gain.

True, the workingman may abuse his privilege in the use he puts of his vacation, but the times he does so are rare. As a rule he takes the family on a tour or just stays home and fixes up around the house or takes a little fishing or hunting trip, and comes back to the old job actually liking it and ready for the harness again.

Statistics prove that the eight-hour day results in the better physical condition of the employee and hence, greater productivity for the firm; statistics also show that the vacation is a good thing for the average man. The "Industrial Revolution" has largely made a machine out of a man, and a little time off gives him the opportunity of reverting to his human state.

He will like his job better, work harder and with more cheerfulness, and produce more in the end.

Selection and Purchase of Coal*

Performance and Specification Methods—Price Adjustments for Variations in Quality

By A. A. Potter and H. L. Solberg

Dean of Engineering, Purdue University — *Ass't Prof. of Mechanical Engineering, Purdue University*

OTHER things being equal, that coal which costs the least per million B.t.u. is the one to be used. Next to heating value, and sometimes of greater importance, is the ash content and its clinkering tendencies. The freight rates per million B.t.u. are likely to be excessive with high-ash coals, and the operator is confronted with the labor and expense of disposing of large quantities of refuse and perhaps of low maximum boiler capacity. The softening temperature of the ash is also important. Coals of strong clinkering tendencies cannot be burned with equal success on all types of stokers. A caking coal can be burned only on a stoker that agitates the fuel bed sufficiently to prevent the formation of a crust. Volatile matter is important inasmuch as it determines the amount of smoke. The design of the combustion chamber and local smoke ordinances may prevent the use of high-volatile coals.

Distance to the mine and transportation facilities should be considered in selecting a fuel, as they bear upon reliability of supply. The tendency of coal to ignite spontaneously during storage is important, as well as the loss of heating value and the resistance to slacking when exposed in piles for considerable periods. Some of these characteristics can be predicted from analysis: others can be determined only by trial. In any case, if these various factors are considered, a survey of the coals available will reduce the list to a fairly small number. Final selection should never be made until a few carloads of each of these coals have been burned to determine the behavior under operating conditions. Selection should be based upon the cost of the coal required to produce 1,000 lb. of steam, the cost of handling and disposing of ashes and refuse, the relative cost of fireroom labor, the cost of carrying banked boilers, the maximum output obtainable from the installation, the responsiveness to changes in load and the clinkering tendencies.

Many operators of small power plants purchase coal on the open market on a hand-to-mouth basis, the only consideration being the cost per ton. On the other hand, some public utilities own and operate their own coal mines. Between these two extremes are a variety of different methods of purchasing coal. Many operators have dealt for years with one or two reliable coal companies. They depend upon the honesty of the coal company to supply them with a fuel suitable to their needs and at a fair price. Since the coal from a given seam and locality is fairly uniform in composition, they may pay the freight on the coal directly instead of purchasing it f.o.b. the power plant and utilize the freight bills as a means of checking the origin of the coal shipment. Such a method is satisfactory for the average coal consumer. Federal, state and municipal departments and large consumers of coal frequently purchase on specifications.

> Most small plants cannot stand the cost of sampling and analyzing coal. The benefits accruing to them under such a system are not sufficient to warrant the necessary expenses. Consequently, the purchase of coal by specifications is done mainly by the government and by large consumers.

In buying on specifications it is customary for the purchaser to state the approximate amount of coal required, the dates and conditions of delivery, method of payment, method of sampling and testing, conditions under which the coal may be rejected, and the method of adjusting the price to care for variations in quality. Each bidder may be required to specify the name and location of the mine from which his coal is obtained, the proximate analysis on a "dry" basis, the average moisture, guaranteed B.t.u. per pound of "dry" coal, percentage of sulphur and fusing temperature of ash. Any of these items may be omitted or included in the data to be furnished by the bidder. The latter guarantees his coal to conform to the data that he furnishes with his bid, and the information so furnished by the successful bidder is incorporated in the contract. The final contract should never be signed by the purchaser until a few carloads have been burned under operating conditions.

Most coal purchased under specifications is bought on a basis of B.t.u. per pound of "dry" coal. The moisture content is under the control of neither the seller nor the purchaser and may vary as much as 5 per cent owing to weather conditions. It is unfair to penalize the seller for supplying coal of high moisture content when the excessive moisture may be due to rain. If railroad weights at or near the mine are the basis for payment, the purchaser may set a maximum moisture limit above which the coal may be rejected, but in no case should adjustment for price be made on

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the basis of coal "as received." One common way of adjusting the price to care for variations in quality of the coal is as follows:

$$\frac{\textit{B.t.u. per lb. of "dry" coal delivered}}{\textit{B.t.u. per lb. of "dry" coal guaranteed}} \times \textit{price per ton of standard quality.}$$

By this formula the cost is adjusted in proportion to the heating value, a method that is fair to both parties. The seller gets a bonus for supplying coal better than called for; the purchaser is reimbursed by the penalty provision if the coal is not of standard quality. An allowance of 2 per cent either way from the standard should be permitted before making price adjustments, because of errors in sampling and analyzing and because the seller does not have absolute control over the quality of his coal.

Coal of high ash content is very objectionable, not only because of the reduction in heating value, but because of the decreased efficiency and capacity and the cost of disposal of the refuse. An additional penalty or bonus provision is often included in specifications to take care of variations in the ash content. One method of correcting the price for variations in ash content is as follows:

$\frac{1}{2}$ [*(Per cent of ash in coal by test) — (per cent of ash in coal by guarantee)*] $\times$ *bid price per ton in dollars = cents to be deducted per ton from bid price.*

If the coal is lower in ash than called for by specifications, the foregoing result becomes negative and is a bonus to be paid the seller.

To illustrate the method, assume a bid price of $3 per ton, a guaranteed ash content of 10 per cent and an actual ash content of 14 per cent. Then $\frac{1}{2}$ (14 — 10) $\times$ 3 = 6 cents penalty per ton. In no case should an adjustment be made for a variation of less than 2 per cent in ash content.

Another method of correcting the price of ash variations is as follows:

Let X = per cent of ash in "dry" coal as guaranteed in specifications.

Per cent ash.....	X–4 to X–5	X–3 to X–4	X–2 to X–3	X	X+2 to X–3	X+3 to –X4	X+4 to X–5	X+5 to X–6
Correction per ton...	+7c.	+4c.	+2c.	0	–2c.	–4c.	–7c.	–12c.

In this table plus signs indicate a bonus, minus signs a penalty. A maximum allowable ash content may be specified, above which the coal may be rejected. The adjustment for variations in ash content is added to the price adjusted for variations in heating value to get the net price paid.

Since the analysis and heating value on a moisture and ash free basis of coal obtained from a given mine is practically constant, specifications are often used in which the adjustment is made on the basis of ash content only without a calorimetric determination of the heating value. As the latter varies inversely as the ash content, if all other factors are constant, the price may be adjusted as follows:

$$\frac{100 - \textit{(per cent of ash by test, dry basis)}}{100 - \textit{(guaranteed per cent of ash, dry basis)}} \times \textit{bid price per ton} = \textit{adjusted price per ton.}$$

For instance, if the bid price is $3 per ton, the specified ash content is 10 per cent, and the actual ash content is 14 per cent, then the actual price paid will be $\frac{100-14}{100-10} \times \$3 = \$2.87$ per ton. This method is applicable to the smaller plants since the determination of the ash content is simple and relatively inexpensive.

As a rule, no penalties are provided as to sulphur content, although excessive sulphur may be a cause for rejection of the coal. It is inserted in specifications in many cases merely to serve to identify a coal and prevent substitution of another coal. The softening temperature of the ash is a desirable part of every specification, as the submission of these data by each bidder helps to narrow the field of available coals.

Advantages and Disadvantages of Specification Buying

The purchase of coal under specifications has several advantages. All bidders are put on a competitive basis. The purchaser is assured of a supply of coal of uniform and known quality. A definite basis is provided for adjustment of the price in accordance with the quality of the fuel, which, if the specifications are properly drawn, is equally fair to both the seller and the purchaser.

There are some serious disadvantages to the purchase of coal by specifications. One is the cost of the analysis and the difficulty of securing a representative sample. Unless the sampling is automatically done by a special machine that removes coal from a conveyor at regular intervals, accurate sampling is a laborious process that is generally neglected. The seller has no positive assurance that the small sample on which the analysis is made and the price adjusted accurately represents the coal in a shipment of several hundred tons. His representative is seldom or never present to watch the sampling process. He has to trust the purchaser to collect a fair sample, and it must be admitted that the collection of an accurate sample is a difficult job at best. There is a general feeling that the seller is at the mercy of the buyer. To protect himself, he may quote a higher price for his coal. Many reliable coal companies feel that their word should be trusted and dislike bidding on a specification basis.

The Large Diesel's Place in Industry

The Diesel of under 500-hp. has justified its existence as a source of cheap power. But what about large engines up to 15,000-hp.? Is there a place in industry for such units? An answer to this query is given in next week's issue by E. B. Pollister, General Manager, Busch-Sulzer Brothers Diesel Engine Company. Those who appreciate the necessity for cheap power will find Mr. Pollister's ideas authoritative—and better still —impartial.

Four Years of Progress in
High-Pressure Boiler Design

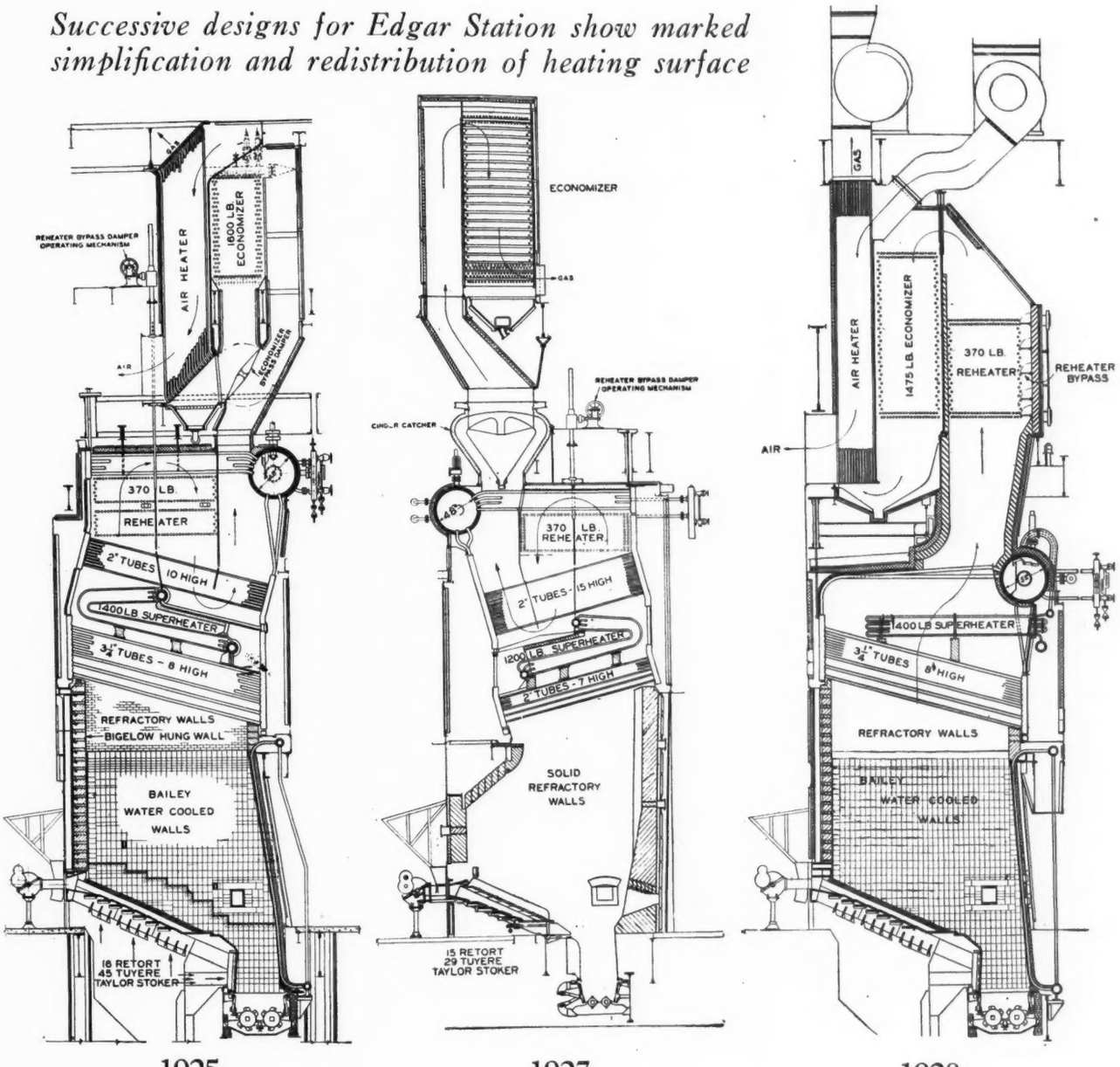
PROGRESSIVE improvements in boiler design based on operating experience with 1,200 lb., or more, at Edgar Station of the Edison Electric Illuminating Company of Boston, are clearly indicated in the accompanying cross-sections. These designs cover a period of little more than four years.

Fig. 1 represents a cross-section through the original 1,200-lb. B. & W. boiler which went into operation in 1925. This had 15,732-sq.ft. of water heating surface and was designed for 143,000 lb. of steam per hour. It is operated at about 130,000 lb. per hour. Two-inch outside diameter tubes were used, the reheater was a part of the setting, a cinder catcher was employed, but no air preheater.

The next two boilers, represented by Fig. 2, were designed for 1,400-lb. pressure and a steam output of 250,000 lb. per hour, although the actual water-heating surface was slightly less than that of the first boiler. A much larger stoker was employed and the greater driving rate necessitated the substitution of water-cooled walls in place of solid refractory walls. The arch was eliminated and an unrestricted area provided for passage of the gases to the tubes. The cinder catcher was omitted.

Based on operating experience with the first boiler,

Successive designs for Edgar Station show marked simplification and redistribution of heating surface



1925 1927 1928

where slagging between the lower tubes was encountered, the lower bank of 2-in. tubes were replaced by 3¼-in. tubes having greater spacing. An air preheater was also added.

The two latest boilers now being built are illustrated by Fig. 3. In arrangement they will be somewhat simpler than the previous designs and will have a different distribution of heating surface, less of the work being done by the boiler proper. Although having the same rating, 250,000 lb. of steam per hour, it has been possible to reduce the boiler-heating surface from 15,090 sq.ft. to 6,971 sq.ft. by the elimination of the upper bank of 2-in. tubes and the addition of more economizer surface. The reheater has been removed from the boiler setting and placed above the boiler at the same level as the economizer and air preheater. This permits the boiler drum being placed much lower. Moreover, the drum diameter has been increased from 48 to 52 in. to permit a somewhat greater water capacity.

As a result of the experiences described in *Power* of March 13, 1928, the refractory faced blocks covering the water walls are carried all the way down instead of having metal-faced blocks at the fuel line. Also, the high pressure superheater will be of the series type.

Getting Oil Out of a Refrigerating System

By Robert S. Wheaton

THE keeping of a refrigerating system free from oil is such a relatively simple matter that it is strange that the subject has to be mentioned. Possibly it is because some people do not realize that a drag is put on a plant when oil is present on the inside surfaces of the piping or when the condenser holds foreign gases.

Oil in the pipes is due to one defect—the oil used to lubricate the compressor was not removed completely by the oil separator. As the years go by, oil is constantly supplied and the amount present in the system continually increases. Designers of plants know this and install oil-drain valves at low points of the coils.

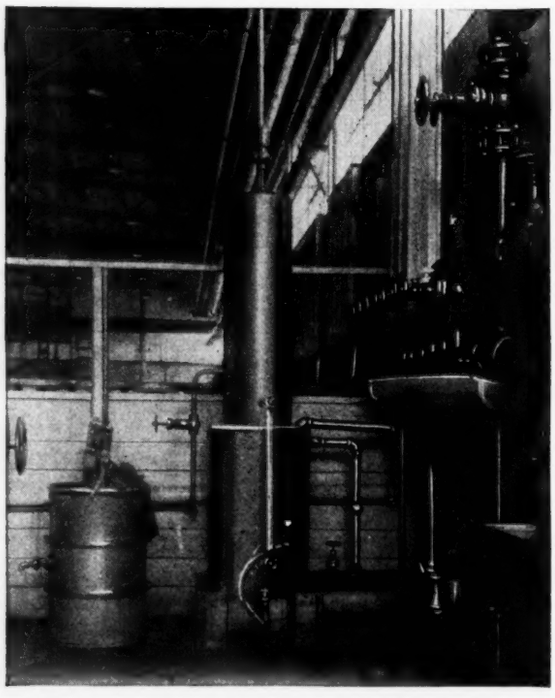


Fig. 1—An oil purifier in a Western ice plant

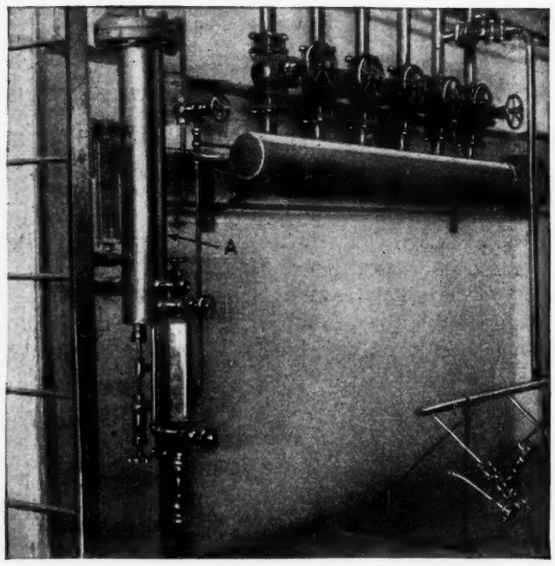


Fig. 2—A purger is a useful part of the plant

Sometimes an ammonia purifier is also utilized, but as there are fair-sized plants that do not have ammonia purifiers, attention is invited to this inexpensive but very effective device for maintaining the ammonia charge at top efficiency at all times.

A typical ammonia purifier, or regenerator, as it is sometimes called, consists of a vessel for holding about 60 lb. of ammonia which is to be cleaned, a heating element (usually a hot-water jacket around part of the vessel), for hastening the evaporation of the ammonia, a liquid connection to a low point of the system where oil will collect, and a suction line from the vessel to the suction line of the ammonia compressor. A pop safety valve and a pressure gage are essential accessories. Such a piece of apparatus is shown in Fig. 1.

In operation a charge of ammonia is introduced into the purifier through the liquid line. The liquid line is closed; the suction line is opened and the water jacket put in operation. When the frost leaves the purifier, we know all the ammonia has been distilled off. The suction line is then closed, and the oil and water, if any are present, are drained out of the purifier through a drain valve connecting to the low point in the purifier. This process is repeated as required.

For the removal of foreign gases from a refrigerating system without interfering with the normal operation of a plant, several devices have been placed on the market. They all work on the principle that if ammonia gas containing foreign gases is cooled by means of liquid ammonia, the foreign gases will be freed when the ammonia gas condenses. The foreign gases can then be purged from the system without the loss of any ammonia. The devices vary, of course, in design and methods of operation. All, however, are based on the principle that as the temperature of a mixture of ammonia and foreign gases is reduced, the percentage of ammonia in the mixture decreases by reason of the decrease in vapor pressure. A typical purger is shown at *A* in Fig. 2.

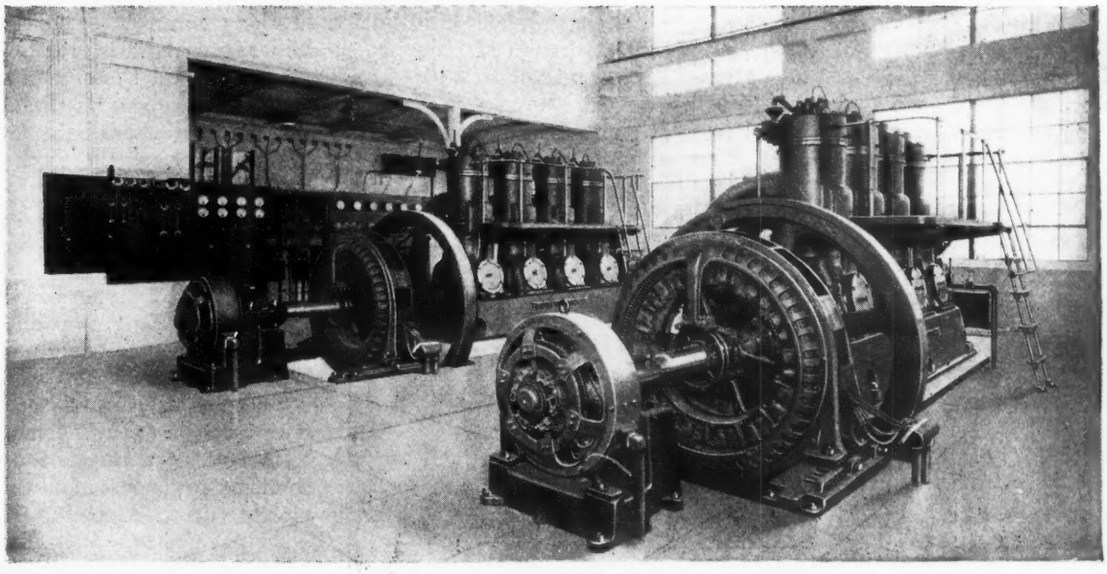


Fig. 1 Engines in the Blossom, Texas, local plant

DIESEL ENGINES

Make Transmission Lines Unnecessary

By G. Grow

THE experience of some utilities shows that under certain conditions it is more economical to develop territories with local Diesel plants than with large steam plants and long transmission lines.

In the last decade so much has been written and so much has been said about the advantages of superpower and interconnection of public-utility plants and systems that the economies of a system with local plants and no interconnection have been forgotten.

A study of power development shows that the large steam station received its great impetus from the evolution of the steam turbine. The turbine is much more efficient in large units than in small ones, not only in the reduction in pounds of steam per kilowatt-hour, but also in the fact that the development of a highly efficient boiler room is more practical in large stations than in small ones. Quite naturally, the development of the large steam station has led to the distribution of electrical energy over networks.

With a further growth in power developments the networks of different systems were interconnected, and with still further increase in size of steam power stations and with tie-ups with water-power developments the term "superpower" came into existence.

It was only about fifteen years ago that the Diesel engine really came into any definite consideration as a part of the power picture. The previous fifteen years' development in the Diesel engine had been mainly in connection with small engines and the development of large units did not begin until the patent rights in the United States expired in 1912 or 1913.

Many engineers who have made a thorough study of the possibilities of the Diesel engine, are convinced that this type of prime mover offers many definite advantages in the development of small, highly efficient, power plants generating energy at or near the point of consumption, as compared with the development of large steam plants at points remote from the place of use.

One important factor in favor of the Diesel engine is its efficiency in small units. This prime mover has made possible, for the first time in power history, the development of a small plant which is just as efficient as a large plant. It is evident, therefore, that smaller power plants equipped with Diesel engines can be installed in various communities of a territory and thus eliminate the transmission networks necessary to supply such communities from one source. The disadvantage, of course, in such a plant is in the fact that the total station capacity necessary to handle the peak load of all the individual communities may be higher than the station capacity required to handle the sum of those peaks from one station. In other words, the diversity factor, or the fact that the peak load in the various communities is not reached at the same time, means a reduction in total capacity. This advantage of a diversity factor is much overrated, for in most systems the individual peak load periods are not widely separated.

In districts where the load is not strung out along a transmission line, but instead is confined to communities miles apart, the adoption of the individual plant reduces the invested capital of the holding company. This is for the reason that high-tension transmission lines have a heavy initial cost regardless of the amount of transmitted energy. Many of the long transmission lines operate at

a distinct loss until the load has been built up considerably.

With the individual plant other units can be installed as the load grows. Each plant is essentially a base-load plant, and the owners do not have the condition, so prevalent with superpower systems, of one plant operating efficiently on a base load, while other plants tied into the same line are practically unloaded and have low efficiencies.

The Diesel-equipped power plant located in the community also has a number of other distinct advantages. In the first place the service is independent of storms. One of the most difficult problems in the operation of a power system is due to the interruption of service because of outages on transmission systems. This may be due to lightning, to insulator failures, to lines going down in sleet storms or to towers being blown over in hurricanes or tornadoes. When the plant is located in the town, the extent of a service interruption of this kind is limited usually to one or two circuits of the local distribution system. It is true, of course, that a plant must have reserve capacity to meet an emergency situation should serious trouble develop on one of the Diesel units in such a plant. The reliability of a modern Diesel engine is such, however, that there is no longer any resistance to the Diesel power idea from that point of view.

If, in the case of the central development, service interruption protection must be given by having reserve or stand-by plants at a number of points, then the main advantage of the centralized system is lost. In other words, the initial investment is greatly increased as compared with the use of local Diesel plants and the gain in efficiency made by the large steam station is offset by the inefficiency and stand-by losses of the reserve plants.

In a transmission network the total losses frequently run as high as 20 per cent of the total power generated. This has made up the losses in the primary, or high-voltage, system and the losses from the substation to the points of consumption in the community. In the local-plant type of development, the losses are confined to about 5 per cent, with 10 per cent as the maximum figure.

The location of the Diesel plant is not restricted by water requirements as is the case with the steam plant. The steam plant must have large quantities of cooling water for condensing purposes and this frequently has more to do with locating the plant than any other one factor. It is for this reason that mine-mouth plants have not been practical. The Diesel plant requires a small amount of water for cooling purposes and if desired this can be recirculated over a cooling tower as is done in most installations.

The local-plant type of development has another important advantage in the fact that the utility company operating on this basis becomes an important part of the community development. Instead of having a substation in the community, with collectors from some out of town office to handle the accounts, the power company employs its plant operators from the town and maintains an office which is usually a complete unit in itself and which becomes a part of the community. Then, too, the community has the benefit of the taxes on the plant and distribution system instead of only the taxes on the distribution system. In the large-plant development the city or community in which the plant is located gets all the tax benefit, whereas with the local plant practically all

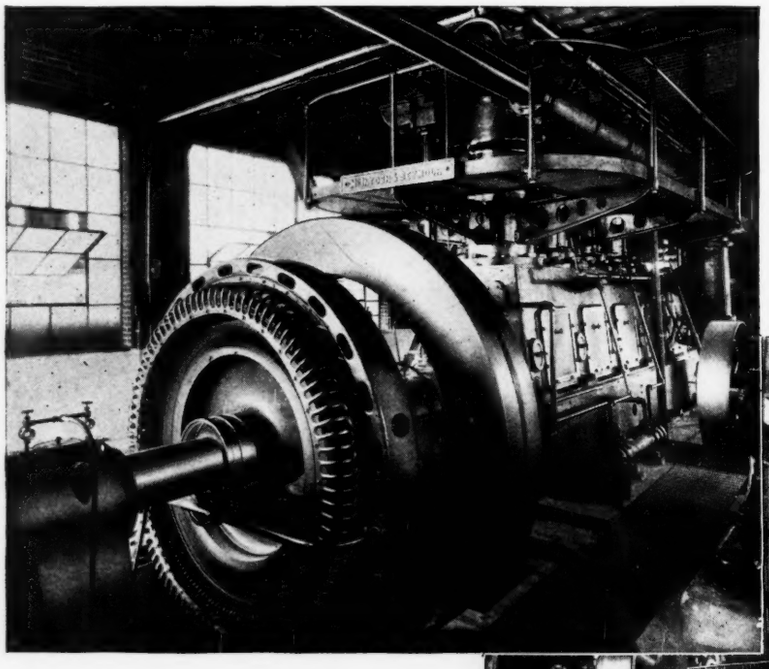


Fig. 2 (above)—Diesel plant at Clifton, Texas

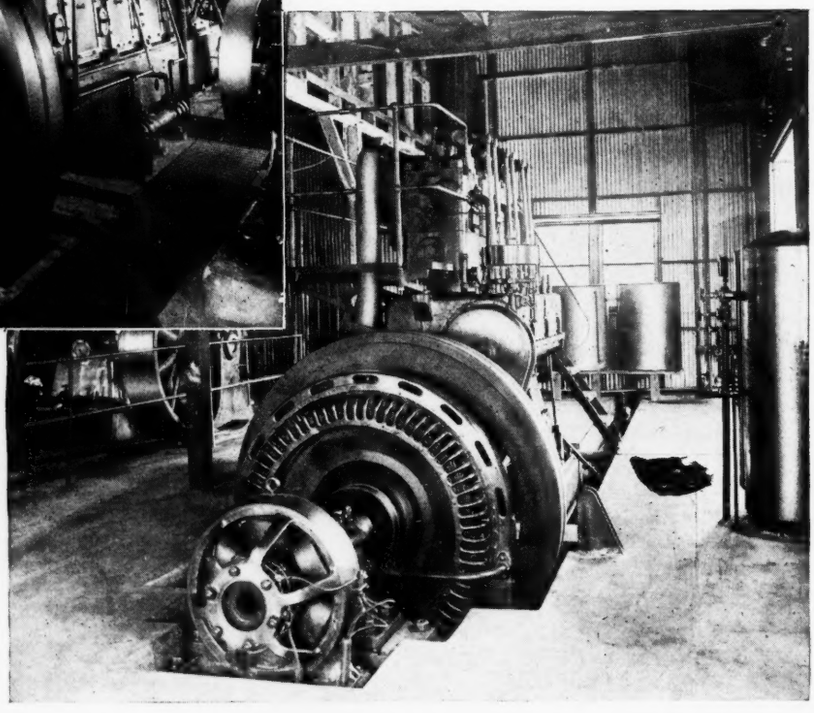


Fig. 3 (Right)—Diesel in the Lordsburgh, New Mexico, plant

the communities share in their portion of income almost on the basis of proportionate power consumption. The local manager becomes a factor in the community and if the utility company has a broad view of its obligations to the community, everyone is satisfied and there is then no bitter fight over the question of whether the community is to own and operate its own plant.

Where the Large Diesel Comes in

In areas of greater population density there is a much stronger argument for the large steam plant development and the network system. In this case the transmission network bears a much lower cost relation to the total investment, since the same poles and transmission towers are loaded to their maximum capacity. The rights-of-way of the networks thus carry greater loads with a proportionate reduction in cost per kilowatt-hour transmitted. With the development of larger Diesel engines, however, the field for the local type of plant in utility development has unquestionably been extended. Even fairly large cities might logically be served from a number of Diesel plants located at load centers in various sections of the city.

It is not possible to generalize on the economics of the problem for any particular section of the country. Each problem must be studied on the basis of its own economic factors and without prejudice. Neither the cost of the Diesel plant nor the service which it will render are any longer subject to argument. The facts are definitely established and the public utility field is today facing the same possibility of changing viewpoints on the whole power development problem as was faced at the time the steam turbine made its appearance. The Diesel engine of today has become an important factor in the solution of any power problem and will become increasingly important as the years go by.

The Texas-Louisiana Power Company has made an excellent contribution to public utility development with its local plant system. The organization has taken an old principle of operation and brought it up to date by the use of the newest and most efficient of modern prime movers.

That the local public utility plant has a definite place in power development and a place of increasing, rather than decreasing, importance is shown by the experience of this utility.

This organization is one of the newer utilities that has shown a striking growth in the last two years. It had originally been planned to develop the various sections of the territory with large steam-operated stations with distribution over the territory through a transmission network. A study of the possibilities of Diesel power, however, led to the conclusion that a large number of smaller plants to serve the individual communities or in some cases groups of communities, would offer a better return on the investment and many other definite advantages as compared with a network system. That the conclusion was a sound one is seen by the fact that this organization now operates, as subsidiaries, the Kentucky Central Power Company, the Texas-New Mexico Power Company and the Texas Gulf Power Company. The Texas Gulf Power Company operates in south Texas and the Texas-New Mexico Power Company operates in west Texas and New Mexico.

Typical Diesel Plants

One of the latest plants is the Blossom, Texas, plant of the Texas-Louisiana Power Company, which recently went into operation equipped with two 240-hp. Fairbanks-Morse Diesels direct connected to 200-kva. alternators and exciters. This plant, in addition to serving the town of Blossom, also serves some of the surrounding towns and has been laid out so that another unit can be installed when necessary. The plant, Fig. 1, is an exceptionally clean-cut installation.

In Fig. 2 is shown a 400-hp. McIntosh & Seymour Diesel at the utility's Clifton, Texas, plant. This unit supplies energy to Clifton and other neighboring towns. A 650-hp. Diesel at Hico, Texas, is shown in Fig. 4. This plant also serves a number of near-by towns. In New Mexico the utility has a plant at Lordsburgh containing the solid-injection Diesel shown in Fig. 3.

The policy of this utility is to install oil engines in the larger towns in its chosen territory and run short lines to the adjacent towns of smaller population. As a result electricity at low rates is available in the sparsely settled portions of the Southwest. Doubtless the same plan can be adopted in other sections with equal success.

Of course, where coal is extremely cheap, as in Pennsylvania and Ohio, the steam central plant will generate current more cheaply than will an oil engine plant. But where the distribution charges are set down, the advantage of the steam plant is not so evident.

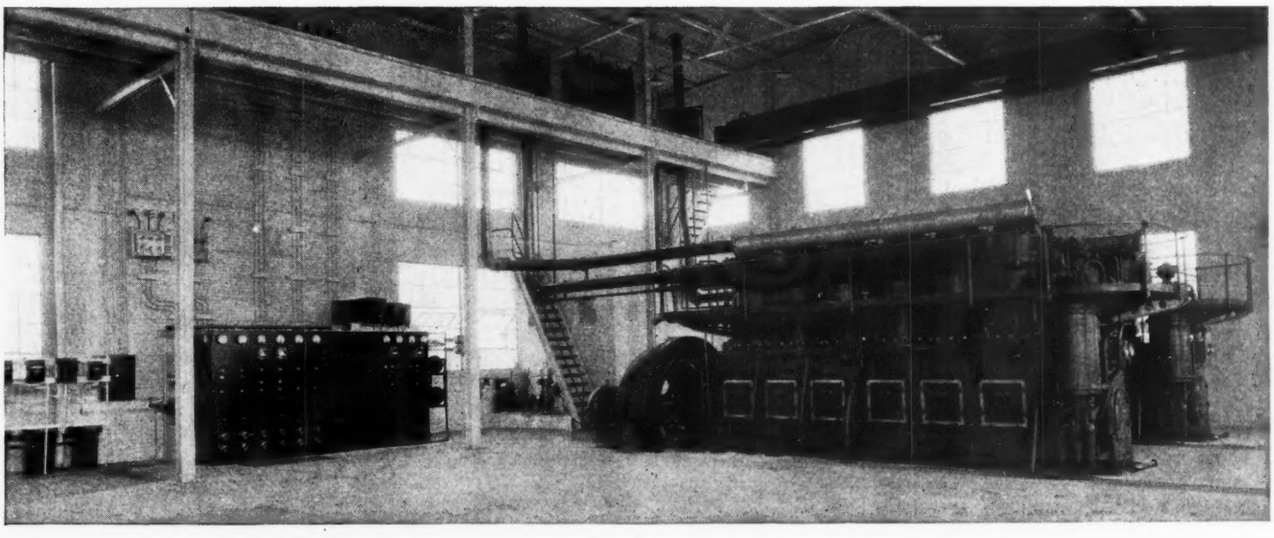
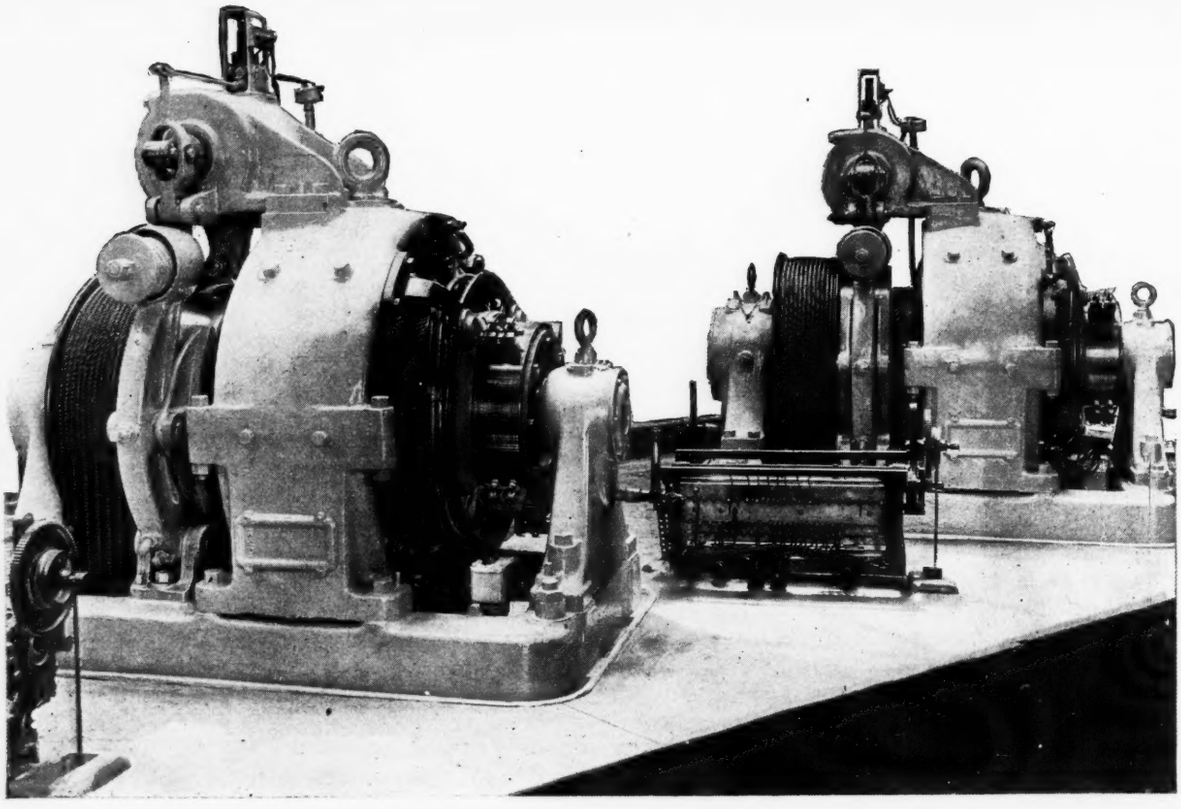


Fig. 4—A 650-hp. McIntosh & Seymour Diesel at Hico, Texas



Two direct-traction type elevator machines

How to Make Periodic Inspections of Elevators

By John A. Dickinson

Research Associate, Elevator Research Fellowship, U. S. Bureau of Standards, Washington, D. C.

THE proper place at which to start routine inspection has long been a subject of debate. I was recently given a summary of inspection routine of fifteen or twenty experienced elevator inspectors working for one of the large casualty companies, and the order in which the parts were inspected was not the same in any two. A uniform method of inspection would have two advantages—first, the danger of overlooking some important pieces of machinery or equipment would be lessened, and second, the reports would be much more uniform.

Suppose we start with the hoistway doors, always an important consideration. If the inspector takes over the car and operates it in the usual manner through the car switch, car buttons or, in the case of hydraulic, controller lever or rope, the logical procedure would be to run the car up the shaft, making a stop at each landing. The action of each door in opening and closing should be carefully noted, and if they are equipped with interlocks or contacts an effort should be made to start the car from each landing with the door opened. In the case of door-closer types of interlocks it is well to establish the point of door closure at which the car may be started. Interlocks of this type, if equipped with four-inch drag links should not permit the starting of the car until the door is within three inches of full closure. The condition of hangers, guides and all other operating equipment on the door should be examined carefully.

Where the doors are dependent upon the ordinary door latch to hold them closed, an effort should be made to open them by pulling on them without touching the latch. A surprisingly large number of elevator doors may be opened in this manner. Worn hangers are often a contributing cause to this type of door failure. If a door can be lifted one-eighth inch or more, it is frequently possible to slide it by the latch from the landing side.

All too frequently, inspectors are prone to allow worn hangers and worn latches to continue in service, because they believe that the doors are old and it is of no particular importance to keep them properly trued up. A

survey of elevator statistics shows a surprisingly large number of fatalities and serious injuries due to falls down the elevator shaft. Something like 36 per cent of all the fatal accidents are due to this cause. The importance, then, of making sure that doors are securely fastened from the landing side of the hoistway becomes evident. Any door that can be so opened should receive immediate attention.

This article is based on a paper presented at the convention of the Certified Boiler and Elevator Inspectors of California. While the inspection procedure outlined is intended primarily for insurance company and government inspectors, it applies equally well to those in charge of the equipment in all classes of buildings.

Another item of considerable importance is the question of properly guarding openings in these doorways. Broken glass in hoistway doors should be replaced immediately, and new installations should not be permitted to go into operation until all doors are properly glazed. A certain large Eastern hotel was recently put into service before the service elevator was completed. As this was a modern fireproof building, the doors were all solidly constructed with only a small light, approximately one foot square, which was to be glazed with wire glass. The elevator was put into service before this glazing was done. A maid, endeavoring to find this elevator, put her head through one of these openings and was almost instantly decapitated. Accident reports show a considerable number of similar accidents partly due to someone putting his head through a frame from which glass has been broken.

While the run is being made up and down the hoistway, the condition of landing sills should be noted, and where beveled boards have been installed underneath projecting sills, they should be checked to see that they are solid and securely fastened.

The action of the brakes in making stops and of the hoisting engine in starting the car, should also be carefully noted. The inspector can almost invariably tell by the nature of the stop whether the brake setting is approximately correct. The question of acceleration is more difficult, but any undue jump of the car should be checked by watching the controller. If the fingers of the acceleration switch close in pairs or groups the jumpy car action is almost sure to result. The pick-up of such switches should be uniform and in proper sequence.

Probably an inspection of the cables might well come next. Most inspectors, I think, prefer to make this inspection from the top of the car, having the operator raise the car in about three- or four-foot steps and examining the cable where it is attached to the counterweight and then in series of steps until the car is at the upper end of its travel. Where the machine is overhead, this will leave one short length of cable to be examined where it goes over the driving sheaves or winds on the drum. Where the machine is in the basement, the cable may be examined from the top of the car, but in this case it will be necessary to make a final check on the end sections both at the overhead sheaves and at the machine in the basement.

The question when to order the renewal has been a source of endless controversy. There is no hard and fast rule that will apparently hold in all cases. In some cases the ropes may show a relatively large number of broken wires and yet the distribution of these breaks be

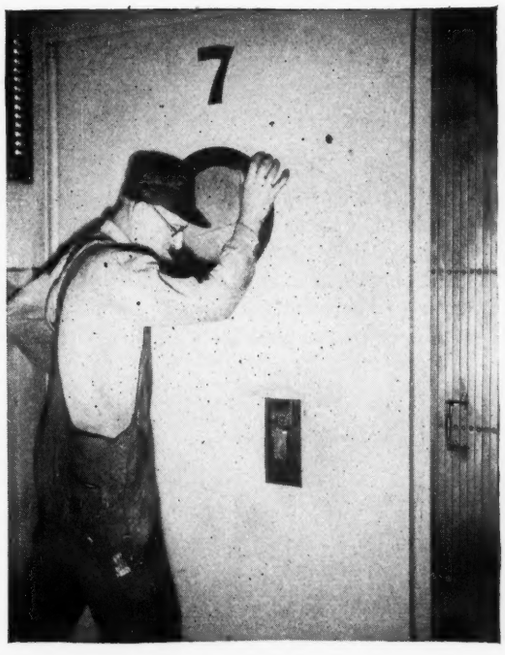


Fig. 1—An effort should be made to open the doors without touching the latch

Fig. 2—The cables should be inspected from the top of the car

Fig. 3—While on top of the car the counterweights should be examined

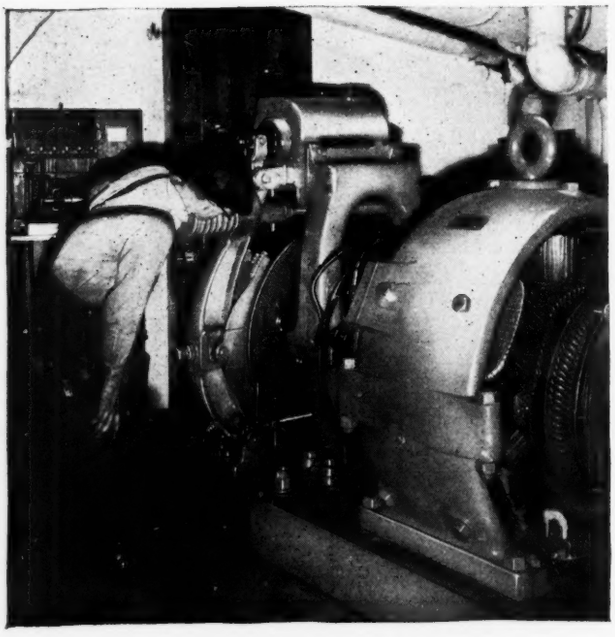


Fig. 4—The action of the brake should be carefully checked

such that the inspector feels that the ropes may safely be used until the next inspection is made. On the other hand, a comparatively few broken wires in the same strand or in two strands may indicate a dangerous weakening of a rope's strength, even though the remaining strands appear to be sound.

There is, in one of the British Admiralty rules, a method of determining the point at which cables should be removed. This is based on the allowable number of broken wires in a certain length of rope which is taken as a multiple of the rope diameter. The weakness of any criterion of this sort is that it does not take into account the location of the broken wires nor does it take into consideration the number of strands affected.

For a long while efforts have been made to develop a non-destructive test for wire rope, but to date there has been no method devised which may be depended on under all operating conditions, although some definite progress has been made.

At the Elevator Manufacturers Convention last spring, Professor Whittemore, of the Bureau of Standards, suggested that the change in Young's modulus of elasticity of wire rope might possibly be used as a check on the strength of rope in service. In order to apply this in the field, it would be necessary to clamp the rope somewhere near the top of the shaft and apply a certain definite proof load, say for example, equivalent to the full-load capacity of the car. The stretch of the cable under this loading being known, the modulus of elasticity could be computed. From the viewpoint of actual operation this might be simplified by preparing a table showing the allowable stretch say in sixty-fourths, for a given load for a given number of cables of certain size and material. As soon as the stretch under the proof load exceeds this safe maximum, the rope would be condemned.

While on top of the car the counterweight fastenings should be examined. The tierods should be carefully checked to see that locknuts and cotter pins are in place and that the counterweight cannot move horizontally, either parallel or perpendicular to the face of the counterweight guide rails, any more than is absolutely necessary to secure free running. The machine, or overhead sheaves if the machine is located in the basement, might well be taken next. The sheave should be examined carefully for worn grooves and all spokes and rims should be hammer tested.

Where there is suspicion that there may be a crack in some part, such a crack, if it exists, may be located as follows: Swab the entire arm or suspected section of the rim with machine oil. Allow to stand a few minutes and then wipe dry, after which apply a coating of chalk, and the crack, if any, will be indicated by the stain on the chalk by the oil seeping from this crack. Hammering of the suspected part lightly with a machine hammer will expedite this test. Wherever any indications of a crack are found in the sheave, the elevator should be shut down and not permitted to run under any circumstances.

The machine should be gone over carefully and parts examined to see that there is ample oil and that there is no excessive play in bearings. The action of brakes should be watched while the car is actually operating, and the amount of brake lining should be noted. Where such lining, whether of leather or composition, is worn thin, even if the brake action is still satisfactory, it would be well to order a renewal prior to the next inspection. This is a point that is frequently overlooked, the owner feeling that the brakes are satisfactory until excessive slide begins. The motor commutator should be examined, and if pitted or dirty, the engineer or mechanic should be instructed to clean the surface.

If the machine is worm-geared, the worm should be carefully examined through the opening provided for the purpose and the amount of end play or thrust developed in starting and stopping the car should be also observed. While the end plate is open on the case, the condition of the lubricant should also be observed. In some installations this is not changed over a period of years and will gum up or turn rancid and lose its lubricating qualities. Obviously, no worm gear should be allowed to continue in service where backlash has developed or where the teeth have worn to such extent as to present a hazard due to the possibility of the gear teeth being stripped.

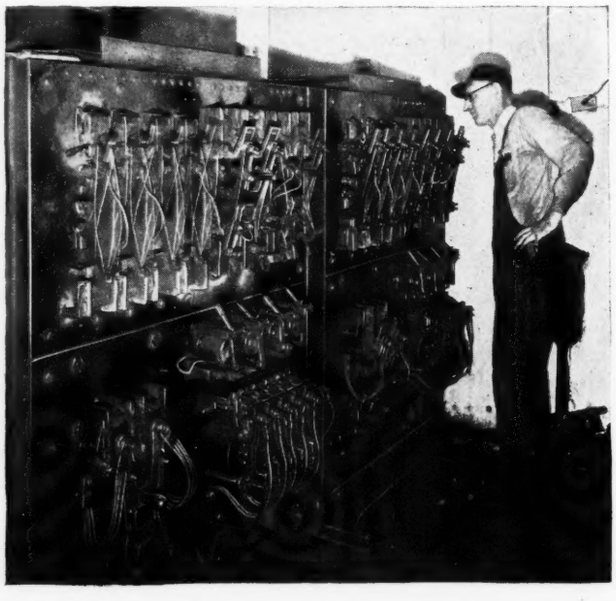


Fig. 5—Examine the controller to see that none of the contacts is so badly worn as to cause unsafe operation

The controller should be carefully examined to see that none of the contacts is so badly worn or pitted as to fail to operate satisfactorily. Where contacts of carbon to copper are used, serious accidents have resulted from the burning or breaking out of the carbon, allowing the metal holder to come in contact with, and actually become welded to, the copper contact.

If the start of the car has been unsatisfactory for any reason, the action of the acceleration switches should be carefully watched while the car is being started and stopped. It occasionally happens that one of the acceleration switches will stick and not drop when a stop is made. In such cases the instant that the contact is

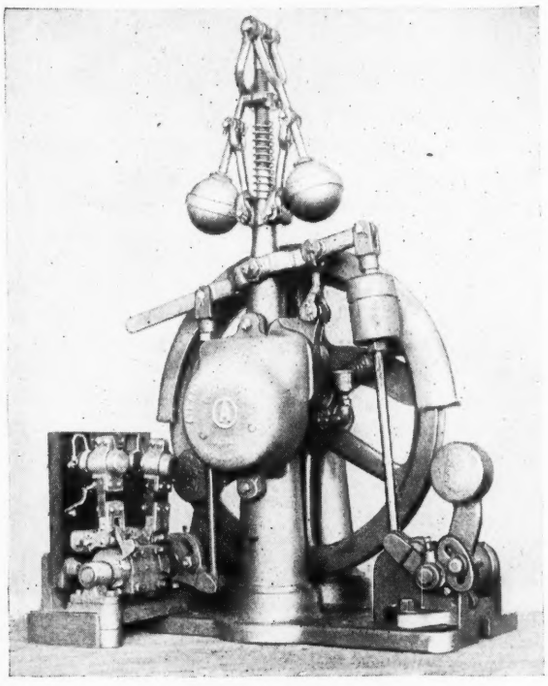


Fig. 6—The governor should be inspected and the flyballs lifted by hand until the rope-gripping jaws are released

made by one of the direction switches there is a sudden and decidedly unpleasant jump to the elevator. Such action is hard on the motor and equipment connected to it Any such conditions should be called to the attention of the building owner, engineer or elevator attendant. The inspector should never attempt to make such adjustment even when requested to do so by the owner. These last two statements apply to insurance company and government inspectors and not to those in charge of the elevators.

The under-car safety should be examined from the under side of the car, preferably from the pit, and the safety drum rope, or tail rope if the safety is of the wedge clamp type, should be pulled out by hand, allowing the jaws to lock the guide rails. If the drum cannot be rotated by pulling on the rope by hand, it is probable that corrosion or grit interferes with the proper functioning of the safety, and instructions should be issued for the owner to have it thoroughly overhauled and lubricated. The governor should be similarly inspected and the flyballs lifted by hand until the rope gripping the jaws are released. The governor should then be carefully reset, taking care that auxiliary contact switches, where provided, are also reset.

At least once every year we believe that the safety should actually be set with the car running either by tripping the governor by hand or by overspeeding the car to the point that the governor will actuate from overspeed. Many of the insurance companies do not make actual locking tests of the safety once a year, depending rather on the acceptance test or by pulling out the safety-drum rope by hand. The objections to such tests are that they will not show weakness of the governor rope or its fastenings.

In the case of instantaneous safeties they should be examined to see that the roller is free to move when properly actuated and that the roller itself has not become deformed or otherwise injured from previous applications. Where the safety is actuated solely through the slackening of cables, it is advisable to lower the car well into the pit, lash the counterweight and then jack the car up until the slack rope is obtained.

The buffers should also be examined while the inspector is in the pit. Oil buffers should be examined to see that they contain sufficient oil. Most buffers are provided either with a sight gage or with a try-cock at the proper oil level. If the oil does not flow out from such a try-cock, the owner should be instructed to have additional oil added. The buffer should be carefully watched while the car is run onto it and should not stick after the car is again picked up.

The weighted idler sheave on the bottom of the governor rope should be examined to see that it is clear of the bottom of the frame. Where compensating ropes are used, the clearances of the compensating rope idler should also be checked.

While this inspection outline is probably incomplete in certain details, particularly where hydraulic equipment is involved, it is offered with the hope that it may possibly present certain new phases which will be of interest.

Series and Shunt Field Coils Have Wrong Polarity on Compound Motor

THE series and shunt field coils have opposite polarity in a compound motor, they produce several effects, depending upon the strength of the series field. It may cause only a slight increase in speed from no load to full load, but in most cases it will cause one of the following effects:

1. Motor may start and operate satisfactorily under no load. When load is applied it may suddenly increase in speed and spark badly at the brushes, causing the fuses to blow, or trip the circuit breaker.

2. Motor may decrease in speed to the point where the fuses will blow and, if not properly fused, may stop, reverse and run in the opposite direction. This will be accompanied by severe sparking at the brushes.

3. Motor may start in one direction, and when the starting resistance is partly cut out, it will stop, reverse and run in the opposite direction.

4. May fail to start, the armature usually making slight efforts to turn in one direction and then in the other.

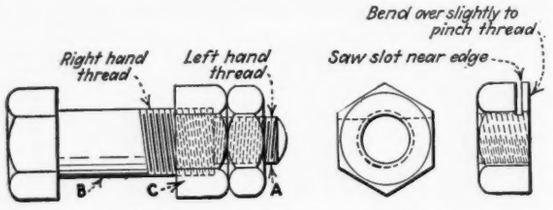
5. If the series field coils are of the proper proportions, it will give the motor a constant speed from no load to full load. This condition is seldom, if ever, found except in motors that are designed to accomplish this purpose.

Right Out of the Plant

BOILED-DOWN EXPERIENCE PASSED ALONG TO THOSE WHO MUST SAVE MONEY, IMPROVE THE PRODUCT AND KEEP THE PLANT RUNNING

Check-Nuts That Stay Tight

I HAVE on occasions, while making repairs about the power house, found need for a strong yet simple bolt with a check-nut, as it is often necessary to make repairs in a great hurry in order to keep the plant running. I took a regular bolt, as shown by Fig. 1, and turned part *A* down to a smaller diameter and threaded it left-



Check-nut has left-hand thread

hand, so any tendency to loosen the nut *C* would tighten it against the check-nut. Part *B* was left as before. Fig. 2 is another method of making a check-nut.

Lewisburg, Pa. C. A. MARTEN.

* * * *

Quicker Handling of Stores and Supplies

MANY industrial plants with large stockrooms and supply depots still count their small parts by hand. Even the stationery supplies are counted card by card or sheet by sheet. When one realizes the uniformity of production of today, it is a waste of time to count by hand. Larger units can be used with accuracy.

Take, for example, small bolts, nuts, washers, etc., where certain numbers are ordered from stock for a job. Instead of counting the exact number of pieces separately, almost equal accuracy could be obtained by merely weighing out a definite quantity, corresponding to the number desired. A placard should be placed over each bin, tabulating the number of pieces to the pound or fraction of a pound. Or if a computing scale is used, the number of pieces corresponding to each weight could be listed on the drum, just as the prices of the given weight can be quickly ascertained from the rate marked above the drum. Hence, the quantity of material desired could be increased until the desired number of pieces corresponding to the weight predetermined is indicated. This would certainly expedite the handling of small supplies.

In the case of stationery, cards, forms, sheets, etc., while weights would be used, thicknesses form a quicker unit. The thickness of the sheets or cards scarcely varies, so that an inch of cards will contain a definite number of cards. Of course some research would be necessary to determine the proper standards. Hence, the thickness of the batch of papers serves as an excellent method of counting high-grade paper stock, etc. Such information for each given stock item would be tabulated on the bin for quick reference.

These general methods of distributing such supplies are useful in cutting the time of these operations. They could be applied to most business, not only in the storeroom, but in other departments. L. G. JONES.

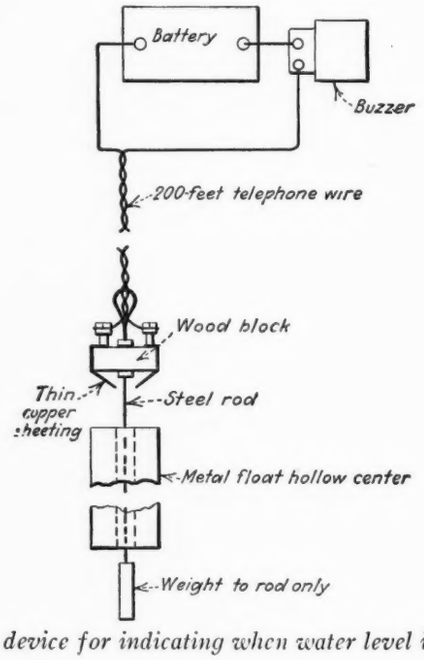
Pittsburgh, Pa.

* * * *

Ready Method of Finding Depth of Water in Deep Well

WHEN a prospective buyer of a deep-well pump is asked what is the depth of the water in his well now and what it will be when pumped at the rate of say 500 g.p.m. for a certain length of time, he does not have the least idea. The man recommending pumps for this service must know the level to which the water will fall upon being pumped, because the efficiency of the pump as well as several other factors vary with the total net pumping head.

In a recent instance I was asked to devise a means of measuring the depth of water in a new bored well approximately 150 ft. deep with 12-in. casing and 6-in. water



Electric device for indicating when water level is reached

pipe already installed. The device shown in the illustration was found to work accurately. The float was lowered until it reached the water, which caused the electric circuit, including a buzzer and battery to close and ring the buzzer. Then the pump (air lift in this case) was started up and the well was pumped at the rate of 350 g.p.m. for 30 minutes. Then the float was lowered slowly until the buzzer rang, giving the new water level. This outfit was built of odds and ends found around the plant. R. H. PARRISH.

San Antonio, Tex.

Safety Method of Lighting Oil Burners

OWING to an explosion in our furnace that tore boiler doors and arch blocks from their setting and seriously burned the attendant, we decided to make changes in our method of starting the burners. Lighting oil burners is a dangerous thing at times, and one cannot be too careful about instructing men as to the proper methods to pursue.

The device that we have developed for lighting the oil-burning furnace consists of a No. 10 gage iron shield placed at right angles to the front of the boiler, on which there is a firing device for lighting the fires while standing behind the shield. A gas pipe for city gas passes through the shield with a valve on the outside. There is a vibrating coil which operates from a bell-ringing transformer on a 110-volt alternating-current line and a push-button switch arranged underneath a wire-glass window through which the operations may be observed. The wire from the coil leads to the tip of the gas pipe. The coil is a Ford spark coil with one terminal grounded to the gas pipe, the other terminating at the gas pilot so as to effect a spark gap. Additional features are two controls, one for oil and one for air.

The employee lighting the fire is instructed to have the damper fully open, and the blast gate should be open for a few minutes and then closed tight.

By turning on the gas and pressing the push button, a spark is produced at the pilot-light burner and the

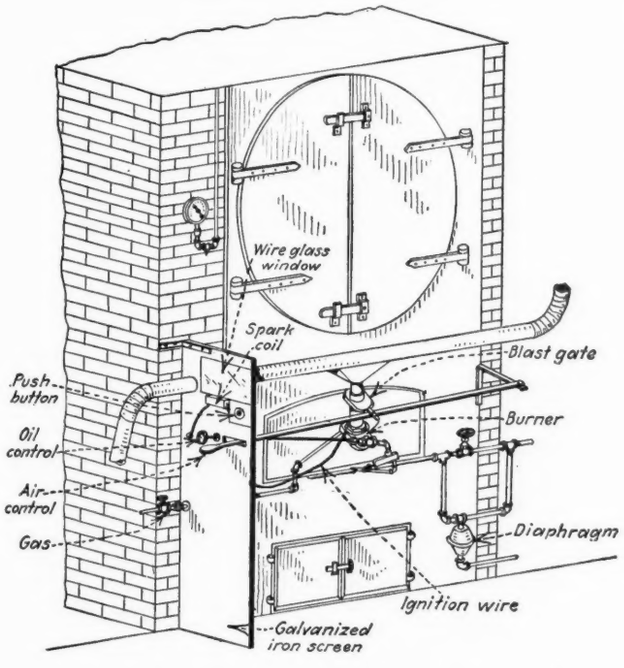


Fig. 1—Arrangement of oil burner and controls

pilot started. The oil is then turned on and the intensity of the fire regulated by opening the blast gate. When the initial small fire has been burning for some minutes, the air and oil controls are opened until the proper fire is obtained.

The tip of the pilot light gave us the most trouble. We solved this by placing a piece of $\frac{1}{8}$-in. pipe in a block of firebrick cement and pressing in a piece of wire as shown in Fig. 2 and then baking it in a furnace to harden.

The illustration, Fig. 1, shows the general arrangement of the lighter, which we have found much more successful than the method formerly used, namely, oily waste and hand gas torch. We also have installed an emergency switch on the power circuit to the oil pump and blower at the other end of the boiler room, so that in an emergency the furnace can be shut down without going near the burners.

Experience has taught us not to depend on the incandescence of the brickwork to ignite oil burners of any

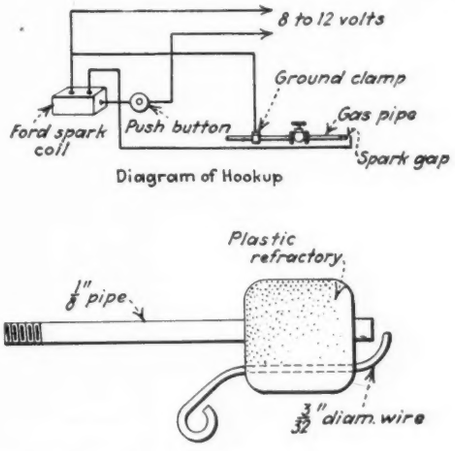


Fig. 2—Diagram of ignition hookup and detail of pilot

type once they go out, even only for a few minutes. Hand torches are not safe and should, in our opinion, be discarded, as they require the attendant to get too close to the burners when starting up. We insist that the damper and blast gate be left open when starting the burners and that the pilot light be kept lighted, in case the burners should go out after starting.

Bridgeport, Conn. G. C. MAUTER.

Fire Risk from Lubricating Oil in the Power Plant

IN A local power station one of the lubricating oil pipes on a 5,000-kw. turbine-generator set started to leak where the pipe entered a flange. While the plant engineer was examining it, the pipe blew out of the flange, and the oil spurted onto a near-by steam pipe carrying steam at 650 deg. F. As the oil was pumped by an automatic pump, it, of course, pumped more oil as the pressure fell. The temperature of the steam pipe was sufficient to ignite the oil, and a small fire started, which was kept up until the oil could be diverted away from the steam pipe. The flames caught some match boarding near-by, but, fortunately, the fire was put out before any great damage had been done.

This is not the first case in which fires have been started through similar causes. It is important that the lubricating oil piping on a turbine should be kept free from leaks and in good condition, and where they are run close to steam pipes carrying high-temperature steam, precautions should be taken against the oil being splashed onto them. The temperature at which the light lubricating oil used in turbines ignites will vary slightly with the grade of oil used, but is usually around 625 to 630 deg. F., and as many power stations use steam temperatures in excess of this, the need for precautions is obvious. W. E. WARNER.

Brentford, England.

As the Other Fellow Sees It

WHERE THE MAN WHO AGREES OR DISAGREES WITH AUTHORS OR EDITORS HAS A CHANCE TO SPEAK UP

Does the "Home-Made" Policy Pay in the Power Plant?

I WAS much interested in the letter of L. G. Jones in the July 10 issue on "Does the Home-Made Policy Pay in the Power Plant?" It is my opinion that in most cases it does, and my question would be why pay forty dollars for parts that actually cost around sixteen dollars to make in your own shop or why pay upward of a thousand dollars for auxiliary attachments that actually cost about one hundred? Generally, the "stop and starter" type of engineer is not a good designer, but why condemn the whole class?

At the present time especially, manufacturers, through the use of modern machine tools and appliances, should be able to manufacture certain parts for much less money than the consumer, but in many cases this is not so.

This subject is of special interest to me, for I have designed and built more or less steam equipment that compares favorably with that put out by the manufacturer.

C. W. PETERS.

New York City.

* * * *

V-Shaped Slots Cause Commutator Trouble

CHARLES W. WARD'S letter, on page 1112, *Power*, June 19, in which he comments adversely on the practice of cutting V-shaped slots in the mica between the commutator segments of direct-current machines, has one point in parallel with an experience I observed in a street-railway substation. Being new in the electrical business, I was hired as night wiper. The plant, at the time, was being changed from a 25-cycle to a 60-cycle station. One at a time, the rotary converters were removed and replaced with motor-generator sets. The final plant consisted of six 1,500-kw. 600-volt direct-current generators, each direct connected to a 2,150-hp. 60-cycle 11,000-volt synchronous motor, with a 125-volt exciter overhung on the direct-current end of the shaft.

One of these machines was run all night to carry the load. The duties of the night wiper were to blow out two machines thoroughly with an air jet each night and wipe all five of the units that were shut down. This work had to be finished by 5 a.m., when the day load began to come on, and all six machines were in service within two hours.

Shortly after being installed, the brushes on No. 1 machine began sputtering, and one morning there was a particularly bad case of sparking that started as soon as the machine was put in service.

Next night, I thoroughly blew out around the brush-holders of all five machines, and just before starting up I carefully wiped off the commutators. Next morning, No. 1 cut in with the usual display of fireworks, and this was a regular performance every day. During all this time, however, the other machines gave no trouble whatever.

The theory was then advanced that, as some concrete work was being done at this end of the house, cement dust was getting onto the commutator of No. 1 machine. As soon as the concrete work was finished and the machine room cleaned up, the commutator of No 1 was trued up, but the brushes still sparked. The erecting man from the electric company that supplied the machines then asked that he be allowed to go over the commutator with the slotting tool. This ended the trouble, and it did not recur during the eight months I remained at that plant.

I inquired of the electric man if he could tell what caused the trouble. His explanation was that while the slots appeared to be deep enough, actually they were V-shaped, with a narrow band of high mica on each side of the commutator segments. These mica strips were like light springs, which prevented the brushes from riding smoothly on the surface of the commutator, hence the sparking. When cleaning out the slots, he was careful to use a cutter with sharp square corners, sufficiently wide to span the entire width of the slot, so that the side mica that caused the trouble was removed.

Later, with another company, I was employed in two substations that had direct-current railway machines. When cleaning these machines, one of the requirements was that the commutator slots be carefully cleaned out. The tool used for this purpose was a home-made hook ground out of a power hackshaw blade. When these commutators were all gone over with a slotting tool, the chief operators made sure that the cutters had sharp, square corners, and were wide enough so that they left no side mica in the slots.

HOWARD LIVINGSTON.

Los Angeles, Calif.

* * * *

Brighten Up the Boiler Room

IN THE July 10 issue is an editorial entitled, "Brighten up the Boiler Room," in which attention is called to the various benefits accruing to the worker and owner through the use of aluminum paint in the boiler room.

Undoubtedly, too little consideration has been given this important factor in stimulating the worker's interest in his work. It has been proved in many instances that light colors are best for a boiler room because they induce more frequent cleaning and do not absorb much light. Aluminum paint should be chosen for the color because it will prominently display dirt, and it will be more restful to the eyes of the workmen than darker shades.

The use of color in the boiler room will be greeted with enthusiasm because it will suggest more natural surroundings. The expense of painting the machine will be quickly returned by the increased efforts on the part of boiler-room employees. Painting the room with a light shade of color will do much to relieve the effect of depressing surroundings and will tend to prevent eyestrain. Uniformity in the color scheme will create a most pleasing appearance. Black is a shade not gen-

erally associated with cleanliness. When the boiler room is painted black, it gives the room a somber and dark appearance, which tends to hide dirt. The selection of a neutral color, such as light gray aluminum, will brighten up the room. To the man who has been accustomed to working in a dark and gloomy plant, one in which the colors are light and pleasing will be a distinct relief and an incentive. Such an innovation shows an active interest in the workmen on the part of the management, and it cannot fail to strike a responsive chord. The increased amount of light available will be surprising, which in itself is conducive to high-quality work, while it is an undisputed fact that the worker's interest in his job will be increased thereby.

Philadelphia, Pa. A. DAVIDSON.

* * * *

Power Brains for Industrial Problems

THE editorial in the July 17 issue, entitled "Power Brains for Industrial Problems," stresses a point that many an industrial plant has been negligent in taking advantage of. There is one phase of this suggestion that is of prime significance—the fact that the power-plant engineer's training causes him to think continually in terms of permanent solutions. Generally, in the rush of production the industrial man is concerned only with a certain run or at best something that will take care of the situation for the future. Ofttimes his period of employment is of indefinite duration with permanency entirely subordinated to first cost. The power man tackles his problem from the viewpoint of minimum cost when applied to and spread over an installation of maximum life. The gain is self-apparent.

The very qualities which enabled the power engineer to build a successful power installation often are permitted to go stale in the routine operation of the plant itself. Rather than lose an ambitious engineer because there is not enough interesting work for him to do, or retain him at the expense of the loss of his ambition and initiative, isn't it much better to permit him to utilize his excess energy in improving production equipment? To do so saves both the man and the management and still leaves him immediately available for any power emergency. JOHN L. STARR.

Gloucester City, N. J.

* * * *

The Engineer and Accident Prevention

I REGARD the editorial entitled "The Engineer and Accident Prevention," in the July 17 issue, as an able presentation of an important subject.

It is true that in industry the engineer who designs, builds and operates all kinds of equipment has a big responsibility in accident prevention. One of the largest contributing factors in the cause of accidents is carelessness. With the control of carelessness comes reduction of accidents. Safe methods of handling equipment during installation and safe operating methods are means by which industrial accidents can be reduced.

Careless methods of operation have a direct bearing on accident rates just as the location of equipment without thought being given to how it is to be inspected and maintained, offers a fertile field for accidents. A little consideration of the safety feature in the design and location of plant and equipment will go a long way to remove the accident hazard. Moreover, the company practicing safety in design of plant and operating methods, will also do well to call attention of the workers to these features as a means of impressing them with the steps being taken to insure safety.

The habit of the workers in taking chances, due to carelessness or recklessness or ignorance, is a mental hazard which may be largely eliminated through co-operation between employer and employee. It is necessary that new men be given instruction in a language which they can understand, not only in printed form, but through interpreters; for many laborers cannot read the language that they speak. To help the men overcome this drawback, many companies encourage their employees to attend evening classes for instruction in English.

But more especially is education needed along safety lines, teaching the new men concerning the hazards of their work and the means of avoiding them. Such instruction can be given in the form of lectures, or by safety advertising in which the danger of accident is explained and pictured in graphic form. Bulletin boards, general safety-first signs, signs indicating specific hazards, safety rule books adapted to the class of men intended to be reached, magazines or company house organs and moving pictures are a few of the many methods that may be used to call the attention of the worker to the necessity of his playing safety-first.

Therefore, through the aid of the engineer and with the co-operation of employer and employee safety will be made possible in industry and accidents will be prevented.

Philadelphia, Pa. HARRY KAUFMAN.

* * * *

Low Pay for the Engineer

THE letter in the July 24 issue, entitled "Low Pay for the Engineer," gives one much food for thought.

Personally, I do not agree with some of the points mentioned, mainly that the engineer is not in the position to help himself and that his case is entirely different from that of the lawyer and the doctor.

That may be true, but the influx of foreign engineers is partly responsible and the so-called engineers who are willing to accept low salaries, thereby underbidding the real engineers of merit, education and experience.

Furthermore, the engineer should follow the sound ethical and professional business methods of the lawyer and the doctor, and cut out the practice of doing his fellow engineer, and not until then will he reap the just reward for his labors and be on equal footing with the lawyer and the doctor.

No doubt it is reasonable to believe that most lawyers and doctors are able to get their professional fees without any difficulty, not only due to their reputation and the recognition of good work, but due to their associations and affiliations. Therefore, it is up to the engineer to do likewise.

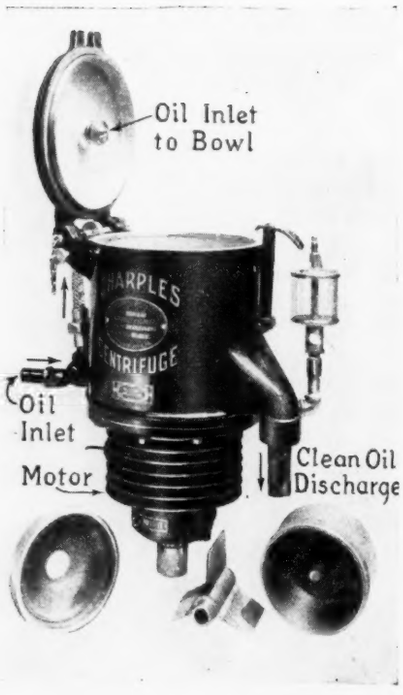
To cite an instance of doing your fellow engineer, a foreign engineer not even an American citizen accepted my position at a lower salary, but he couldn't handle the plant. Therefore, the company had to engage another man and was obliged to pay him a salary that exceeded mine.

The answer is that this company figured that the foreign engineer had more brains and was willing to accept a lower salary than I, an American, and a veteran, but finally had to dismiss him and engage the services of another American engineer, who is still on the job.

Newark, N. J. P. DIAS.

What's New in Plant Equipment

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING TRANSMITTING AND APPLYING THE POWER SERVICES



Disassembled view of centrifuge

Sharples WHIZ-ard Model B-3 Centrifuge

A SMALL centrifuge for purifying fuel and lubricating oil for small Diesel engines (up to 500 hp.), has been brought out by the Sharples Specialty Company, 23rd and Westmoreland Sts., Philadelphia, Pa.

The unit, which is shown disassembled in the illustration, is designed for mounting on the wall or engine frame and to be piped permanently into the system. A ½-hp. vertical type motor is bolted to the bottom of the bowl chamber, and the bowl itself is mounted directly on the motor spindle, running at 10,000 r.p.m. The oil feed is arranged for gravity or pump, and a flexible connection is provided between the feed connection on the bowl chamber and the central connection to the top of the bowl in the cover of the chamber. This flexible connection makes it unnecessary to break any connections in the piping system in order to clean the bowl.

As will be seen from the illustration, the bowl has but three parts, the shell, top and three-wing section. It is 4¼ in. in diameter, 3 in. long and weighs only 4 lb. It has a dirt-holding capacity of 26 cu.in., or approximately 1½ lb. The machine has a capacity of 15 to 25 gal. per hour with fuel oil and 15 to 20 gal. with lubricating oil. The dimensions of the machine are, height 18 in., diameter 10 in., and the weight is 66 pounds.

Cascading Coal Drier

IN THE July 6 issue of *Engineering* London, there appeared a description of a cascading type of coal drier manufactured by the Universal Dryers Company, Ltd., of Queens Road, Barnsley, Yorkshire, England. A general view and cross-section of the machine are reproduced herewith.

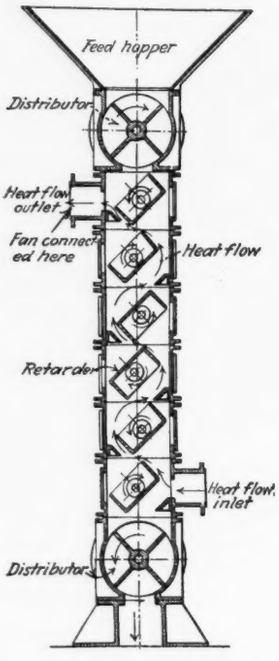


Fig. 1—Section through drier

The machine consists essentially of a series of superimposed rotating troughs. The wet coal is fed into a hopper at the top, from which it is discharged by means of rotating distributor into the uppermost trough of the drier. The latter tips the coal into the second, and the fuel continues to travel from trough to trough in the form of successive cascades until it is finally discharged at the lower end of the machine. During its downward pass the coal meets an upward current of hot gases drawn through the machine by means of a fan at the outlet end. The troughs or retarders revolve in opposite directions, and the design is such that as coal is discharged from one retarder the one directly below it is in the correct position to receive it. The small inclined baffles, which can be seen inside the casing in Fig. 1, direct the streams of falling coal into each rotating trough. The distributor at the lower end of the machine is, in all respects, similar to that rotating in the hopper at the top.

The whole arrangement is driven by means of a 5-hp. electric motor through suitable reduction gearing. The speed of rotation depends upon the degree of dryness required in the outgoing product. The capacity of the machine illustrated is approximately six tons per hour.

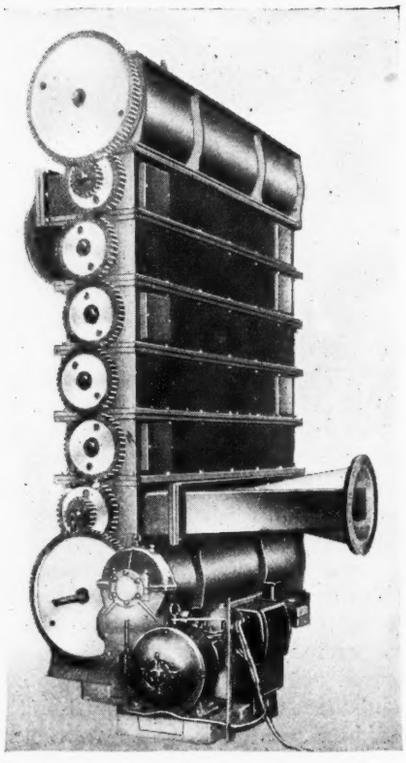
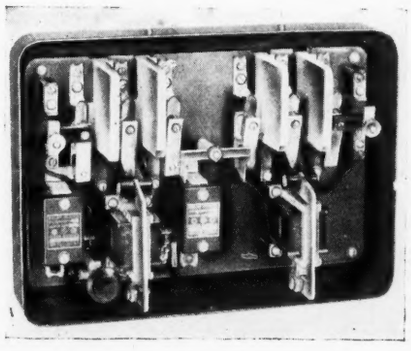


Fig. 2—General view of drier with motor drive

Across-the-Line Reversing Switch

THE General Electric Company, Schenectady, N. Y., announces a new motor control switch suitable for reversing small alternating-current motors in cases where the motor can be thrown across the line. It consists of two triple-pole, barrier-type, magnetically operated contactors, mechically and electrically interlocked, and two hand-reset temperature overload relays mounted on a molded base and inclosed in a drawn-shell inclosing case.

The double-break contactors with silver contacts, operated by a high-speed solenoid, give the switch a high interrupting capacity with minimum arcing. The new type silver contacts eliminate the need for the



Switch with cover removed

shunt straps and minimize contact resistance.

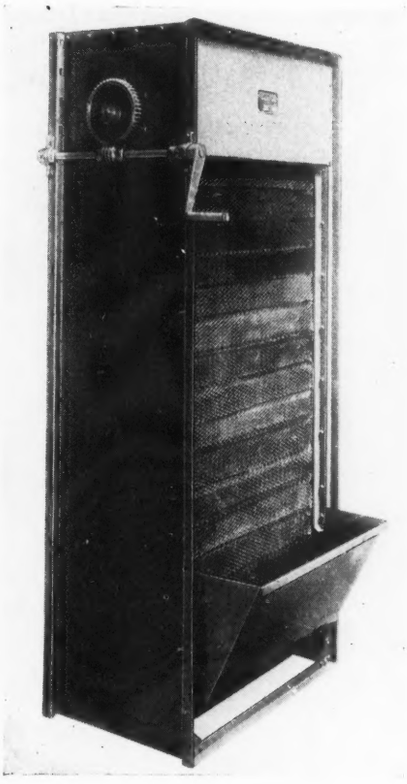
The two temperature overload relays protect the motor from overheating. These relays are a fixed part of the switch, but have interchangeable heaters. To adapt this switch for use with a motor of a different rating but the same voltage, it is merely necessary to select heaters corresponding to the motor current.

The switch is adaptable for use on general-purpose motors when either infrequent or frequent reversing is required and for use on such services as motor-operated doors, valves and machine tools.

National Double-Pass Air Filter

A TYPE of air filter known as the "TooPas," in which the air is filtered twice in the same unit, is the most recent addition to the line of filtering equipment manufactured by the National Air Filter Company, Chicago, Ill.

The filter is built along lines similar to the Phoenix, which has been made for some years by this company. The filtering medium is the endless-curtain type, having small units of multiple layers of woven copper ribbon and expanded metal passing over large supporting wheels at the top and through an oil-cleaning bath at the bottom. This arrangement presents two walls through which air must pass. The whole curtain is encased in a sheet-metal frame, 28 in. wide, 18 in. deep, and in various



"TooPas" Aire Filter

heights, depending upon the opening desired.

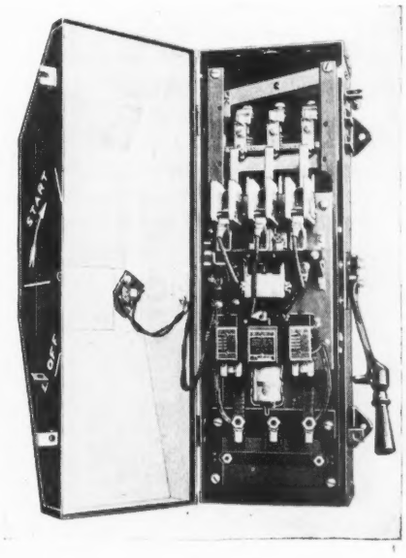
Air enters through the first wall and is accelerated, owing to the small openings in the filtering medium. Oil entrainment is prevented, for the velocity of the air is greatly lessened in the 10-in. gap between the two curtains, and any particles of oil that may be carried along are dropped at the lowered velocity. As an additional safeguard the second wall of the filtering medium serves as a baffle to stop any stray drops of oil.

The curtain, or filtering medium, is cleaned by being immersed in an oil bath at the bottom of the housing. As the dirt accumulates a sludge is formed which can be scraped out through an opening in the front without disturbing the oil. Operation of the filter is by turning the top roller once a week by means of a crank on the side of the casing.

The filter is built in sections which are interchangeable and which can be used in multiple to give the desired capacity.

Allen-Bradley Resisto-Transformer Starters

THE Allen-Bradley Company, 286 Greenfield Ave., Milwaukee, Wis., has added to its line of motor starters the new resisto-transformer



Resisto-transformer starter

starter illustrated. The starter is a combination of the graphite compression resistor and auto-transformer type of starter, giving stepless acceleration with low current input. The manufacturer points out that large squirrel-cage motors can be started without danger of causing line voltage jolts.

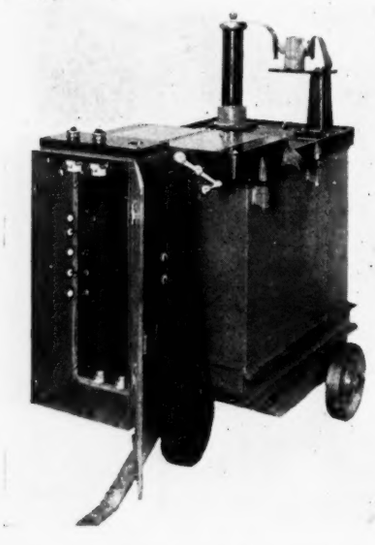
No initial current influx occurs because the compression resistors are connected in series with the auto-transformer when the motor is connected to the line. These resistors permit acceleration of the motor from standstill to slow speed without opening the line connected to the motor. An auto-transformer reduces the line current in proportion to the transformer ratio. At full speed the motor is connected to the line without opening the line circuit, thus preventing the second current inrush. The starter contains the usual protective features.

High-Voltage Portable Testing Set

THE illustration shows a portable truck-type high-voltage set for testing insulation and also transformer and circuit-breaker oil, brought out by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The set has a maximum testing voltage of 50,000.

The complete equipment consists of a testing transformer, auto transformer, induction regulator, oil testing cup and control equipment. This is mounted in or on a rectangular boiler-plate tank, which is mounted on heavy wheels and provided with a tongue for easy transportation.

The transformer of this set is of the oil-insulated, self-cooled shell-type construction. One end of the high-voltage winding is solidly grounded to the tank and the other is brought through the cover. The auto-transformer adapts the set for the different primary voltage ratings, and the change to the desired voltage may be made by only one adjustment. The induction regulator gives a variable



Truck-type insulation and oil testing set

test voltage from zero to 50,000 volts in a continuous smooth curve. Red and green indicating lamps are provided, the green indicating voltage on the supply circuit terminals and the red showing potential on the high-tension terminals.

The control circuit consists of an overload relay with an electrical reset, a double-pole contactor with blowout coils, and a make-and-break interlock for the signal lamps, all controlled from a pushbutton.

Mechanical Atomizing Oil Burner Handles Fuel at Low Temperature

THE ability to atomize properly fuel oil of 14 to 16 deg. Baumé, at a temperature of as low as 100 deg. F. and to handle the heaviest oil at 130 deg. F. are features of the fuel-oil burning equipment put out by Trowbridge & Schellens, 6 Beacon St., Boston, Mass.

The burner (see Fig. 1) carries inside its nozzle a cone-shaped cup mounted on ball bearings with its axis horizontal and its open end protruding slightly beyond the nozzle. The cup is made to spin rapidly by an air turbine that is mounted adjacent to it. Lubrication of the bearings is by oil rings dipping into a reservoir in the rear of the burner casing.

Oil passes through a central spindle

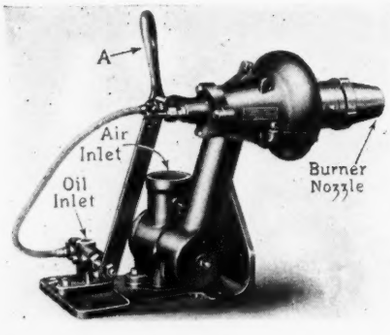


Fig. 1—Burner with air and oil connections

which protrudes through a hole in the closed end of the cup. It drips into the cup, is spread out in a thin film on the inside surface of the cup by centrifugal force, and is thrown off at the open periphery in the form of a fine mist. Air at a low pressure exhausted from the turbine passes out through the annular space between the cup and nozzle, picks up the finely divided oil and carries it into the furnace.

The air stream surrounding the cup keeps the oil film cool while the burner is in operation. However, when it is desired to shut the burner off and to close off its air supply, the gun or burner must be withdrawn from the radiant heat zone of the furnace in order to prevent carbonization of the oil film. The removal of the burner is accomplished by pulling the handle *A* back and swinging the gun away from the furnace on the two pivoted links which form the gun supports. The forward link, which forms a conduit for carrying the air to the gun, is provided with a register at its lower end, which closes off the air whenever the gun is withdrawn.

The burner base is arranged either to bolt to the furnace front or to be mounted on a concrete foundation and will carry either one or two guns hanging on either or both sides of the air connection mounted on it, respectively. Secondary air for combustion is preferably admitted through an adjustable slot in the boiler front

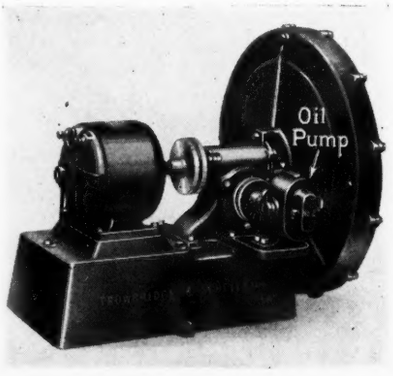


Fig. 2—Fan and oil pump set

below the gun or through checkerwork in the floor of the furnace.

The combined motor-driven fan and pump, shown in Fig. 2, furnishes air and oil to the burner. The fan is of the centrifugal type and delivers air at 6 to 16 oz. per sq.in. pressure depending on the amount of oil to be burned per burner. The oil pump is of the gear type and is driven through a worm and gear on the fan-shaft. The oil pressure varies with the viscosity of the oil, size and length of pipe, etc., and is usually below 35 lb. per sq. in.

Two sizes of fan and pump sets and one size of burner are at present available. No. 1 fan set has a capacity, with a single burner, of 4 to 20 gal. per hour, and with a double burner, 7 to 35 gal. per hour. The air pressure in inches of water required is 10 to 12. The corresponding figures for the No. 2 set are, 5 to 25 gal., 9 to 45 gal. and 18 to 21 in. respectively.

These ratings are based on a motor speed of 3,500 r.p.m., and 14 to 16 deg. Baumé oil that is heated to 130 deg. F.

Other advantages pointed out by the manufacturer are small power requirements, steady and practically noiseless flame, and ability to carry a small flame without danger of going out.

The Right of Employer to the Ownership of a Patent Obtained by Employee

By Leo T. Parker
Attorney at Law, Cincinnati, Ohio

FOR a great many years the law has been established that an inventor is the sole owner of all patents applied for and issued in his name, although the invention is perfected on the employer's time and with the use of the employer's equipment and tools.

In other words, generally speaking, unless a contract exists between an employee inventor and his employer by which the former agrees to assign all inventions to his employer, the inventor retains the right to the patent. However, if the employee used his employer's time and tools when perfecting the invention, the employer has a shop-right to use the patented device or process.

Until recently it was immaterial that the inventor was hired especially to improve his employer's product. The only right the employer retained in patents thus obtained by the employee was known as "shop-right," which gave him the right to make, sell and use the invention, but the inventor was privileged to make, sell and use the invention or license the same to competitors.

However, in the recent case of Standard Parts Company vs. Peck (264 U. S. 52), the Supreme Court of the United States modified this long-established law by holding that an employee who perfects an invention while working on his employer's time and being paid especially to make improvements, has no legal ownership or interest in the patent.

The facts of this case are that a man named Peck engaged to work at a stipulated amount per month expressly to develop patentable improvements of his employer's equipment. Later, Peck obtained a patent on an invention thus perfected and contended that his employer merely held a shop-right to use his invention. However, the court held Peck's employer the sole owner of the patent, saying:

"By the contract, Peck engaged to devote his time to the development of a process and machinery and was to receive therefor a stated compensation. Whose property was the process and machinery to be when developed? The answer would seem to be inevitable and resistless—of him who engaged the service and paid for them."

Therefore, the holding of this recent higher United States Court is in effect that if a patent is granted in the name of an employee and the patent relates to an invention conceived, experimented and perfected on his employer's time while being paid to invent things, the legal ownership of the patent lies with the employer.

Where the patent is issued before the employer is informed of the true conditions, he may apply to the Patent Office, submitting proper proof, and compel the inventor to assign his interest in the patent to the employer.

If, however, the patent is not yet issued, when the employer discovers that the employee has applied to obtain a patent, the employer may institute legal proceedings requesting the court to issue an order commanding the inventor to assign his rights in the patent application to his employer.

Of course, convincing testimony must be introduced before a court will issue an order requesting the Patent Office to transfer the title of an application or already issued patent from the name of the inventor to the employer. And frequently, it is exceedingly difficult for an employer to prove that his employee perfected a patented invention while working at his regular employment.

Moreover, it is important to know that the employer retains no legal rights in the title to the invention, unless it can be proved to the satisfaction of the court that the employee actually worked on and perfected the invention while being paid by the employer *to do so.*

It is equally well established that simply because an inventor is employed and paid to perform certain duties at certain periods, the employer may not acquire the ownership of an invention which the employee conceives and perfects while off his regular duty. In other words, an employer has no statutory or common-law rights of ownership in his employee's patent provided the invention is perfected entirely on the employee's time, unless a contract to that effect exists between the two parties.

For these reasons it is well for employers who desire to acquire rights to their employee's inventions, to request employees who contemplate employment, to sign waivers of rights in certain kinds of inventions which they may perfect.

Also, it is important that the form of this contract does not include unlimited inventions, because if devices not relevant or analogous to the employer's business are expressly or impliedly included in the agreement, the contract is likely to be held invalid on the grounds of public policy and unreasonable restriction.

Clauses that may be relied upon to acquire the greatest rights to the employer, are as follows:

"The employee agrees that he will never reveal to any person, unless authorized by the company or its officials, any information concerning the company's inventions, processes, and in general any of its confidential affairs. In part consideration for the wages now and hereafter paid to said employee by the company, the employee agrees on demand to assign to said company, its successors or assigns, the entire right, title and interest in and to any inventions that he may make during his employment by said company, or within six months after termination of such employment, which inventions relate to any inventions pertaining to the subject matter of manufacturing or experimental work or tests carried on by said company during my employment."

Another common source of litigation is where an employee, who is not under contract to assign inventions to his employer, files an application for a patent on an invention which he perfects on his own time after his employer has suggested certain improvements from which the employee obtains ideas from which to make the invention.

It is important to know that in a controversy of this kind the courts require the employee to prove that he, and not his employer, is the real inventor.

For instance, in the most recent and leading case on this subject, Larson vs. Crowther (1 F. R. (2d) 761,) the employer claimed the right to a patent obtained by his employee stating that he had suggested certain improvements which the employee proceeded to perfect and later patented. In holding the employer entitled to the patent, the court explained the law, as follows:

"The relation between mechanic and inventor is therefore one of high trust and confidence, and the inventor must be reasonably safeguarded against a betrayal of the faith reposed by him in his employee and against a misuse of information confidentially acquired. Because of that relation it is prima facie, but strongly, presumed that the employer, *not* his mechanic, is entitled to patent the invention evolved. Consequently, in any dispute between them as to which of them originated a patentable conception, the duty devolves on the mechanic to establish by a clear preponderance of competent, credible and satisfactory evidence that the invention was his and not that of his employer."

DONALD MACFEE'S COLUMN

. . . James Watt's fame rests but lightly upon the fact that he invented the expansion steam engine. His place in history is due almost entirely to his success as a business man in stamping out competition.

. . . Entirely too much stress is laid upon the engineering ability of engineers. If a man expects to occupy a subordinate position, then he can never get too much engineering education. If, however, he wishes to reach the top rung of success (?), his studies should embrace economics, diplomacy and Rotarianism, with engineering in the far background.

. . . There is some amusement in listening to the warnings as to the demoralizing effect of a governmental monopoly on the public utility field when the prophet is spokesman for a business that is itself a monopoly.

. . . This is how the newspaper reporter explained a ruptured hose.

"Difficulty was experienced in getting water even to the eighth floor because the downward pressure of the water resulting from gravity meeting the upward pressure from the fire engines caused intense strain in the lines of hose, which burst one after the other and had to be replaced."

. . . Although we pretend to disdain it, the engineering that appears in the public press is but slightly inferior to that contained in some of the papers presented before the learned engineering societies; on second thought no inferiority can be charged.

. . . As Alex Bailey stated at a Prime Movers Meeting of the N.E.L.A., engineering may be an exact science, but engineers do as they damn please.

. . . The danger of the machine operator becoming an automaton is by no means a phantasy. True, the cobbler at his last is rated as an excellent curbstone philosopher, but consider the thousand years he spent in learning how to think while carrying on his monotonous job.

. . . A former shoe salesman now selling coal was giving his sales talk to a prospect, *"There is no ash in this coal. Not a bit of sulphur or dirt. It's a wonderful coal." "How many B.t.u.'s are there in it?" asked the prospect. "Not a damn one!" was the clinching answer.* Some coal is like that.

. . . That half of the engineers don't get killed is due entirely to the patience and forebearance of the boilers. According to *The Locomotive*, a fireman finding the supply of water low after cleaning a boiler, shoveled in a lot of sand through the manhole to make the water show in the gage glass. Yes, the boiler exploded, but what is that if the fireman is saved the work of filling her up with hand pump.

. . . The inscription that Henry Ford has over his fireplace, "He who chops his own wood warms himself twice," is thought to express a beautiful philosophy by a lot of people who warm themselves in winter by a gilded radiator, and swear at the engineer for not making it sizzle.

High-Speed Vision*

WHENEVER a new product becomes available in commercial quantities, it is certain not only to replace some older product, but also to find new fields of usefulness.

Neon, one of the rare gases of the atmosphere, a byproduct of the separation of oxygen and argon from air by liquefaction, is no exception to this rule. It first found a use in the neon signs which are rapidly coming into use. But in addition to replacing the older types of electric sign, the neon tube lamp has made possible an interesting machine for studying high-speed motion.

The neon lamp is capable of being illuminated to its full brilliancy and extinguished almost completely in a time interval that is measured in millionths of a second. A rotating object, illuminated by flashes of such a duration and timed to occur exactly in step with the rotation, will appear stationary or moving at a very slow rate of speed.

This phenomenon is often noticed in motion pictures when the wheels of a moving automobile appear to stop for an instant, or even to be turning backward. The neon lamp has made possible the application of this principle of the "stroboscope" to even the most rapidly rotating machines.

One form called the "Stroborama" is of such high illuminating power, 1,000 cp., that it permits an entire machine to be viewed at once in any of its parts without shadows and under conditions approaching normal daylight, so that the relative motions of the various parts may be studied under actual operating conditions. Another type developed by one of the large electrical companies is specifically designed for studying the "lag and lead" characteristics of electrical machinery.

These machines are now successfully used in mechanical industries, hydraulics, aërodynamics, physics, etc. Their applications are numberless. They can be applied wherever fast periodic motion occurs.

Among such motions which have been studied with profit are the operations of the various parts of gasoline engines, especially the action of valves and breaker cams, the flexions of crankshafts and connecting rods, the surges of electrical machinery, slip in the spindles of spinning frames, and vibrations induced in structures by rotating machinery.

This happy combination of the stroboscope and the neon lamp extends the range of man's vision into a new field in a literal sense and promises to solve many hitherto baffling problems. For exhibition and demonstration purposes its field is almost unlimited.

*From July "Industrial Bulletin" of Arthur D. Little, Inc.

Legal Effect of Printed Notifications

GENERALLY speaking, a printed statement or notice on a contract, billhead, bill of lading or letterhead is not effective if the printed statement is contradictory to the body portion of the contract or letter. Moreover, it has been held that a stipulation printed in small, inconspicuous type is not effective unless referred to in the body of the letter or contract.

In a late case (246 Pac. 332) a seller had printed on his order forms the following notification:

"Any claim on the delivery of the goods not in accordance with the terms of the contract will not constitute cause for concellation unless the complaint is made within 15 days time of the delivery of the goods."

This order was signed by the purchaser. Several days after the 15-day period specified on the order had expired, the buyer wrote to the seller explaining that the merchandise did not comply with the samples, and refused to pay the seller.

The seller then sued the purchaser. However, this court held the purchaser not bound by the printed notice, saying:

"It only remains to be considered whether the printed conditions appearing in the upper left-hand corner of the order, which refers to the time within which the objection is to be made to the quality of the goods, formed a part of the contract. . . . The rule seems to be well established that printed conditions on letters or bill of ladings or order blanks *which are not specially referred to or called to the attention of the other party* to the contract, will not be regarded as a part thereof."

The law is equally as well established that where parts of a contract are printed, typewritten, and pen written, the pen-written parts prevail over the printed and typewritten portions, and the type written parts prevail over the printed portions.

According to *Engineering*, the German State Railways are installing pulverized-coal equipment in some of their locomotives. The engines are of the standard design, but the tanks are rearranged to carry the pulverized lignite, which is ground in a central plant. A blower driven by a single wheel turbine supplies primary air, to a maximum of 245,000 cu.ft. per hour, the steam consumption being 430 lb. The fuel and air mixture is pumped from the tender to the burners, through two 6-in. pipes provided with ball-and-socket joints. In series of tests a load 30 per cent greater than is standard, was handled by the engine. Even with a 50 per cent cutoff, the engine operated without smoke.

RECENT PUBLICATIONS

GETTING FACTS ABOUT ACCIDENTS. Published by Metropolitan Life Insurance Company, New York City. Paper; 5x8 in.; 23 pages.

THIS booklet, addressed primarily to the chief operating officials, outlines current industrial practice in obtaining and using facts as a means of promoting safety. It presents convincing evidence of the value of accurate knowledge concerning how and where accidents occur, and also gives a description of methods by which this information may be put to maximum preventive use.

STANDARDS YEAR BOOK, 1928. Compiled by the United States Bureau of Standards. Published by the Government Printing Office, Washington, D. C. Cloth; 6x9 in.; 400 pages. Price, $1.

IN THE first issue of this publication special attention was paid to the organization and procedure of the numerous standardizing agencies in this country with a brief outline of certain national and international agencies. The present volume contains outlines of the activities and accomplishments of not only the National Bureau of Standards and other agencies of the Federal Government, the states, counties and municipalities, but also those of technical societies and trade associations with special emphasis on their accomplishments during the year 1927 and their program for future work. A special feature is made of the accomplishments and current activities of the various foreign national and the several international standardizing agencies. There is also included a bibliography on standardization, compiled in the Library of Congress.

THERMODYNAMICS APPLIED TO ENGINEERING. By Arthur E. Macconochie, Associate Professor of Mechanical Engineering in the University of Virginia. Published by Longmans, Green & Co., Ltd., 55 Fifth Avenue, New York City, 1927. Cloth: 6x9 in.; 260 pages; numerous illustrations and chart of the properties of steam and ammonia. Price, $4.50.

THE author bases his development of thermodynamic theory upon the kinetic theory of matter, and from this deduces by relatively simple mathematical processes the well-known principles underlying thermodynamics. This he does in the first 70 pages of the book, and the rest of the work is devoted to a consideration of power generating equipment. This latter portion of the volume is very brief, and, unfortunately, it appears to the reviewer that the author has failed to make his discussions sufficiently general. For example, in the discussion of the steam engine the text is largely confined to an elaborate description of a single make of uniflow engine, and in the discussion of the Diesel engine the only engine mentioned is the North British sliding-cylinder double-acting two-stroke-cycle Diesel engine, which is hardly typical of general Diesel engine practice today.

The obviously British style and treatment of the text and the frequent reference to British engineering practice to the exclusion of American practice may slightly impair the usefulness of the book to American readers, but only slightly. On the other hand, it seems to the reviewer that the discussion of both theory and practice is unduly brief. Many topics are not mentioned, and others are given treatment that seems somewhat scanty.

APPLIED THERMODYNAMICS. By William Robinson, Emeritus Professor of Engineering and Technology, University College, Nottingham. Published by Isaac Pitman & Son, 2 West 45th St., New York City, 1927. Cloth; 6 x 9 in., 564 pages; illustrated, with complete index. Price, $5.50.

THIS book is addressed to engineering students and to engineers who desire to improve their knowledge of heat engines, and assumes a rather complete preparation in the fundamental mathematics, including the integral calculus.

It is a splendid and detailed discussion of the subject, including many topics that are commonly omitted from elementary textbooks. The method of treatment is characteristically British, with the frequent introduction of numerical examples completely worked out, and the book should therefore be useful not only to students in class, but also to those who might wish to work independently on the subject as a whole, or on special topics.

There are a few instances of unusual arrangement in the order of material, and now and then the reader will find material referred to before it is completely explained. It is somewhat surprising to find Stefan's law and Avogadro's law introduced incidentally to the discussion of internal combustion engine theory. One of them is first stated in a footnote and two pages later is restated under a full-fledged paragraph heading. The other appears under a principal heading as a new subject, as though it were being introduced for the first time, although it is mentioned at an earlier point in the text. These are minor matters, however. The topics are introduced where they fit the author's scheme of presentation, and the index enables the reader who is looking for some small detail to find it without delay.

In the discussion of the steam turbine much attention is given to super-saturated expansion, and this should be helpful to those who wish to secure more dependable results than follow from the usual theoretical treatment.

The book will not prove to be light reading, but is a solid and dependable treatment of the entire subject.

MECHANICS FOR ENGINEERS. By Julian C. Smallwood, Associate Professor, and Frank W. Kouwenhoven, Instructor of Mechanical Engineering, Johns Hopkins University. Published by D. Van Nostrand Co., Inc., New York, 1928. Cloth; 6 x 9 in.; 185 pages; illustrated by numerous diagrams. Price, $2.50.

THE authors claim nothing new except an arrangement and selection of material, and a combination of problems with text for the exercise of the best pedagogy, and an emphasis upon subjects important to engineering students, with corresponding omission or reduction of the less important ones.

It appears to the reviewer that they have accomplished this end very effectively. The work is a concise and clear exposition of applied mechanics on the so-called gravitational system; that is, with force, length and time as the fundamental units, and with mass as a derived quantity. The problems in kinetics are discussed with the aid of the so-called inertia force.

Throughout the book there are numerous problems, and at the back of the book is an extensive collection that should prove of considerable value in relating the discussion of theory to the practical affairs of every-day engineering.

The final chapter on the consistence and conversion of compound engineering units is a brief discussion of a subject that is often very confusing to the student. It seems to the reviewer unfortunate that the authors considered so brief a treatment sufficient. Twice as much would be immensely more useful.

While this book is obviously designed for a classroom text, it should prove valuable to anyone who desires to improve his grasp of applied mechanics. If the reader is well equipped in algebra, he should be able to develop a thorough understanding of almost everything in the book. There are a few places where the calculus is employed, and the reader unfamiliar with that subject would have to take these portions on faith.

A PROPOSED AMERICAN STANDARD FOR SLOTTED HEAD PROPORTIONS OF MACHINE SCREWS, CAPSCREWS AND WOOD SCREWS has been completed by a subcommittee of the Sectional Committee on the Standardization of Bolts, Nuts and Rivet Proportions of the American Engineering Standards Committee. The head proportions of machine screws up to $\frac{3}{8}$-in., and capscrews up to $\frac{3}{4}$-in. are given in this tentative standard. Discussion is invited on these proposed standards, which should be mailed to C. B. Le Page, assistant secretary, American Society of Mechanical Engineers, 29 West 39th St., New York City.

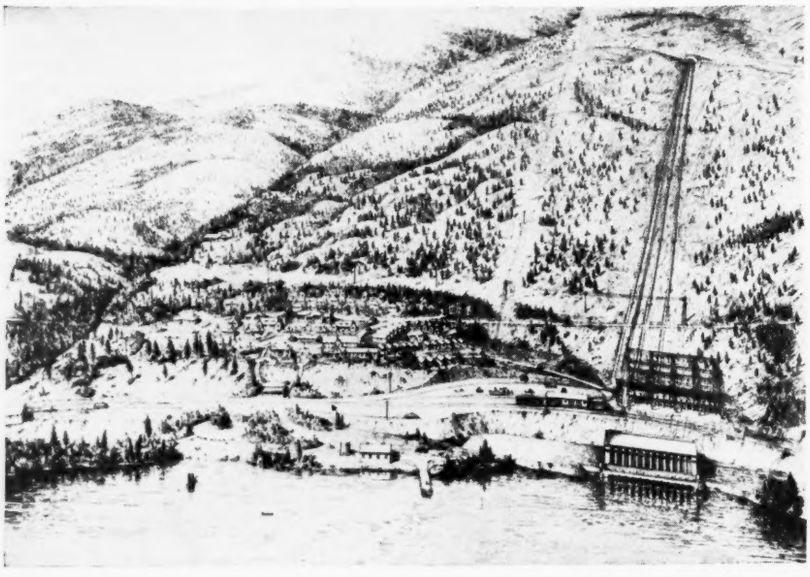
Events and Men in Power's Field

THE EDITORS WILL WELCOME THE CO-OPERATION OF READERS IN REPORTING INTERESTING HAPPENINGS, PERSONAL OR OTHERWISE

Large British Columbia Hydro Project Under Construction

STEADY development is now taking place on the huge power project of the British Columbia Electric Railway Company at Bridge River. While nothing of a spectacular nature has been attempted during the last few weeks, the engineers and men are carrying on steady construction work on the boring of the $2,000,000 tunnel which will connect Bridge River with Seton Lake.

The ultimate development of the Bridge River project will be 700,000 hp., and this will be carried out in easy stages. At present work is under way to develop 60,000 hp. at a cost of $13,271,000. This project will be completed in 1930, and another unit will be added by 1933, which will bring the total cost for the development of the first three units up to $14,700,000 and the capacity of the plant to 90,000 horsepower.



Sketch of the proposed initial Bridge River development showing the penstocks extending down the mountain side to the power house on Lake Seton

Bridge River, which has an average flow of about 3,700 sec.-ft., is one of the main branches of the Fraser. The maximum observed flood on the river is 26,000 sec.-ft. Storage facilities when fully developed will, it is estimated, be sufficient to afford a continuous flow of not less than 3,000 sec.-ft. This under an average effective head of 1,300 ft. will produce about 400,000 continuous horsepower. A few miles before entering the Fraser, Bridge River comes within about three miles of Lake Seton, which is on another branch of the Fraser but at about 1,350 ft. lower elevation. The two are separated by a mountain range, which requires the building of a tunnel 13,200 ft. long to bring the water to the mountainside above Lake Seton. The site of this project is about 130 miles transmission distance from Vancouver.

The first stage of this project consists of log-crib rock-filled diversion dam, a tunnel 13,200 ft. long and twelve feet diameter; a surge tank cut in the solid rock near the power-house end of the tunnel; two steel-plate penstocks five feet in diameter; a station building to house two 20,000-kw. 80 per cent power factor units to be operated by 30,000-hp. double overhung waterwheels; an outdoor switch and transformer installation; and a 165,000-volt transmission line.

It is planned to complete this installation in 1930 and add a third unit in 1933. This will bring the capacity of the plant to 60,000 kw. Future extensions are planned that will bring the capacity to about 700,000 hp. in the ultimate development.

The second stage of the development will probably be deferred until 1938 and will involve driving a second tunnel parallel to the first and extending the power house for 250,000-hp. additional capacity. There will also be a large storage reservoir included in this part of the project that will afford some 750,000 acre-feet of storage. The third stage will require enlarging and lining the initial tunnel, now being bored, and the installation of the equipment to bring the plant to its ultimate capacity.

Zilwaukee Installs New 35,000-Kw. Unit

Increase in the demand for power in Saginaw and Bay City, due primarily to a program of expansion by the General Motors Corporation, has compelled the Consumers' Power Company to proceed at once with the installation of additional generating capacity at its Saginaw River steam plant at Zilwaukee.

The decision to install a new 35,000-kw. turbine generator comes right on the heels of the company's addition to this station of a 30,000-kw. machine which has been in service but a few weeks. The new unit will increase the station capacity to 105,000 kw. for system use, with an additional 3,500 kw. for power-house requirements. Three new boilers will be required to supply steam at 350-lb. pressure to the new machine, making a total of twelve for this plant. The new unit will require an extension to the turbine and boiler house structure and to the substation steel structure.

Plans call for the completion of this unit on July 1, 1929. It will generate at a voltage of 12,000 and the output will be stepped up through autotransformers to the local distribution voltage of 24,000.

Bituminous Coal Conference To Consider Many Topics

Twelve major topics for discussion at the Second International Conference on Bituminous Coal to be held under the auspices of the Carnegie Institute of Technology, Pittsburgh, Pa., Nov. 19-24, 1928, are tentatively announced by Dr. Thomas S. Baker, president of the institution and chairman of the Congress. About one hundred engineers and scientists representing fifteen nations have already tentatively accepted invitations to speak or to send papers to the Congress, and the number of speakers and delegates is growing daily. About 60 per cent of the papers will be delivered by representatives of countries other than the United States.

Although the Second International Conference will be similar in purpose to the first Congress held in 1926, pre-

liminary plans for this year's meeting show that its scope will be considerably enlarged and the program will be more important and more international in character. The discussion of fixed nitrogen is one of the topics which will receive close attention. The liquefaction of coal, which was one of the principal subjects of discussion at the first meeting, will again occupy a prominent place in the deliberations. Low-temperature distillation will be treated by representatives of at least a half-dozen countries. High-temperature distillation, power from coal, coal tars and oils, complete gasification of coal, origin of coal, coal washing, pulverized coal, catalysts and the general aspects of the bituminous coal industry are other topics that will be considered.

The economics of the coal industry will be discussed by Lord Melchett, Dr. Friedrich Bergius and Prof. Dr. Franz Fischer, Germany; Andre Kling and E. Audibert, France. Engineer Guardabassi, Italy, will deal with the subject of the liquefaction of coal.

Low-temperature distillation will be treated by George E. K. Blythe, Dr. C. H. Lander, Harold Nielson and Dr. E. W. Smith, England; Dr. A. Herz, Joseph Plassman and Prof. F. P. Kerschbaum, Germany; Henri Lafond, Prof. Paul Lebeau, Antonie Vonk and A. Leante, France; Prof. Dr. Granigg, Austria; Prof. Yoskikiyo Oshima, Japan; Prof. Samuel W. Parr, Prof. Alfred H. White, and F. C. Greene, United States.

High-temperature distillation: Jean Bing, France; Prof. Ernest Terres, Germany; Edgar C. Evans, England.

Power from coal: Dr. J. E. Noeggerath, Germany; C. Simon, France; A. T. Stuart, Canada; W. B. Chapman and Prof. A. G. Christie, United States.

Coal Tars and Oils: Henri Winckler, France; Dr. L. Edeleanu and Prof. Dr. Fritz Frank, Germany; and Gustaf Egloff, United States.

Gasification of Coal: Dr. Karl Bunte and Dr. Alfred Pott, Germany; Paul Weiss, France.

Origin of Coal: Prof. George L. Stadnikoff, Russia; Dr. Chozo Iwasaki, Japan; Dr. Reinhardt Thiessen and Prof. E. C. Jeffrey, United States.

Fixed Nitrogen: A representative of L'Air Liquide Societe, France; Rudolf Battig, Germany; Prof. Harry A. Curtis, Louis C. Jones, and Charles J. Brand, United States.

Coal Washing: A. France, Belgium; Dr. Glinz, Germany; Dr. R. Lessing, England; F. R. Wadleigh, Dr. F. W. Sperr, James B. Morrow, and Byron Bird, United States.

Pulverized Coal: Dr. I. P. Goosens, Rudolph Pawlikowski, and Dr. P. Rosin, Germany; C. J. Jefferson, United States.

Addresses not yet classified under these headings will be given, it is expected, by F. S. Sinnatt, England; Raymond Berr, France; P. E. Raaschou, Denmark; John Hays Hammond, Howard N. Eavenson, E. E. Slosson, Dr. Arthur D. Little, A. C. Fieldner, and Dr. H. C. Parmelee, United States.

The list of speakers, it is pointed out, will be considerably enlarged during the coming months. President Baker and his associates planning the Congress expect to announce the final program details in October.

In addition to the scientists named, a large number of prominent American industrialists and financiers will be present at the Congress. There were nearly 1,800 delegates at the conference in 1926, and it is expected that the meeting of 1928 will be more largely attended.

Parr Shoals Plant to Get New 30,000-Kw. Unit

Plans have been made by the General Gas & Electric Corporation, New York, controlled by W. S. Barstow & Company, Inc., of that city, for the construction of a third unit of 30,000-kw. capacity in the steam power plant at Parr Shoals, 40 miles from Columbia, of the Broad River Power Company, a subsidiary. This unit will increase the capacity of the Parr Shoals plant to 72,500 kw., the new unit to be tied in with those of the Lexington Water Power Company, another Barstow enterprise, which is developing a water power project on the Saluda River, about ten miles from Columbia, for an initial capacity of 200,000 hp. and an ultimate rating of 275,000 hp. It is likely that the Parr Shoals unit will be ready for operation during the latter part of 1929, or at all events, prior to the completion of the Saluda River project.

Natural Lightning Writes Its Own Record

Natural lightning, that is measured in millions of volts and millionths of a second, has been made to write a record of itself. In the foothills of the Allegheny Mountains near Lake Wallenpaupack, Pa., where engineers of the General Electric Company have been co-operating in experiments and investigations on the 220,000-volt transmission lines of the Pennsylvania Power & Light system for more than three years in an endeavor to ascertain the characteristics of lightning, the greatest enemy of high-voltage transmission lines, a photographic record has been obtained showing the nature of a lightning stroke on transmission wires before reaching the ground. This is the first 220,000-volt line ever built in a lightning-infested territory, the only other line being in California.

This picture, taken Friday noon, July 27, the first of its kind ever made, reveals a stroke on the transmission wires of approximately 2,500,000 volts. It was made automatically by a portable cathode-ray oscillograph, a high-speed camera which can record what happens in a millionth of a second or even a fraction of such a brief interval.

The General Electric Company, in co-operation with the Pennsylvania Power & Light Company, the Philadelphia Electric Company and the Public Service Electric & Gas Company of New Jersey, began this study of natural lightning on transmission lines in 1925. The cathode-ray oscillograph had not been developed at that time, and various types of surge recorders were used. Early this summer engineers of these companies, with Mr. Peek, who is credited with having done more experimenting with artificial lightning than any other engineer and who recently announced an artificial flash of more than 3,500,000 volts, made an inspection of the 65-mile, 220,000-volt lines of the Pennsylvania Power & Light Company, extending from Wallenpaupack to Siegfried, and selected a location for the experimental laboratory in the hills adjoining Wallenpaupack.

Less than a week after the cathode-ray high-speed camera had been put in working order, the awaited thunderstorm arrived and the picture was taken. The negative showed that before five millionths of a second had passed the voltage wave had climbed to more than 1,500,000 volts. A local disturbance, due to an induction flashover and reflection, caused a rise to 2,500,000 volts in a fraction of a millionth of a second. This splash, or ripple, then died down in a millionth of a second and the wave passed to below dangerous value in about ten millionths of a second, then to zero—all in a total of 40 millionths of a second.

Chimney to Be Used to Test Wind Velocity

A 200-ft. chimney that will serve a testing plant for wind velocities as well as for the new power plant of the Bureau of Standards, is nearing completion, the Bureau announces. A series of 24 openings have been built in the stack to serve as gages to measure the wind pressure on a full-sized structure. The full text of the Bureau's statement follows:

In connection with the Bureau's new power plant, now nearing completion, a tall brick chimney has been constructed; besides its normal function the "laboratory in the chimney" is expected to provide valuable test data. The stack is circular in section, 14½ ft. inside diameter at the base, 10 ft. in diameter at the top, and 200 ft. high. The foundation is on the boiler room level, 15 ft. below the street, so the top of the chimney is actually 185 ft. above the ground.

At a height of about 140 ft. above the ground a series of 24 openings are provided around the stack connected by long brass tubes with pressure gages at the base. These gages will measure the wind pressure on the chimney with the wind blowing in any direction. Thus, actual pressures on a full-sized structure can be determined and compared with the results obtained on small models in the wind tunnel. The data are expected to be of great value to architects and engineers.

Turbines in Columbia Station To Be Rebuilt

Additional information has been obtained regarding the changes that are being made to the Columbia station of the Columbia Gas & Electric Company, of Cincinnati, a preliminary report of which was published in the July 24 issue of *Power*.

At present there are installed in this station two tandem-compound units of 50,228-kva. capacity. The high-pressure element is supplied with steam at 600-lb. pressure which is reheated before being delivered to the low-pressure turbine at 100-lb. pressure.

In rebuilding these units, the present high-pressure element will be removed, and the low-pressure element will be equipped with a new bearing pedestal, governor-drive oil pump and speed and emergency governors. Two of the 31,250-kva. generators now at the West End station will be moved to the Columbia station, and two new General Electric high-pressure turbines will be installed with them, making two cross-compound units instead of the tandem-compound units as at present. The inlet pressure to the low-pressure element will be raised from 100 lb. to 185 lb. in order to carry the generator rating formerly carried by the tandem-compound unit. The rebuilt units will each have a capacity of 61,000 kw. at 75 per cent power factor.

Lockwood Greene Engineers, Inc., Takes Over Old Firm's Work

Lockwood Greene Engineers, Inc., has purchased from Lockwood, Greene & Company, Inc., the entire business of its engineering division, including its appraisal department. The new concern is a Massachusetts corporation formed by men who for many years have been continuously associated with the engineering activities of Lockwood, Greene & Company, Inc. The new company will continue to maintain the present offices in New York, Boston, Spartanburg, Chicago, Charlotte, Atlanta and Montreal.

Lockwood Greene Engineers, Inc., will take over all contracts without change in its operating personnel and will continue to maintain the high standards of engineering always associated with the name Lockwood Greene.

An association is maintained with Walter W. Cook and George F. Blount (formerly of the architectural department of Lockwood, Greene & Company, Inc.) under the name of Cook & Blount.

Sea Water Dynamo Generates Power

The dream of limitless power from the sea is taking form in a laboratory set up by Georges Claude, inventor of the method of making of liquid air, at Ougree-Marihaye, on the Meuse River near Liege, Belgium.

Claude recently reported to the Academy of Sciences that a dynamo was being driven by utilizing the 46 deg. Fahrenheit differences of temperature between the surface water and that at a considerable depth. A 50-kw. generator, he said, was producing 40 kw. of power, much more than enough to do the pumping necessary in the process.

This surplus of power produced by nature, Claude announced last year, could be obtained from the sea in vast quantities, particularly near the Equator, where the difference in temperature at considerable depth is great.

This first installation, made to test Claude's calculations, is expected to be followed by a more elaborate plant.

Coming Conventions

American Society of Mechanical Engineers, Twin-City regional meeting at St. Paul, Aug. 27-30; Boston regional meeting, Oct. 1-3; second national fuels meeting at Cleveland, Ohio, Sept. 17-20; Calvin Rice, secretary, 29 West 39th St., New York City.

Canadian Steel and Power Show at the University of Toronto Arena, Sept. 4-7; Campbell Bradshaw, secretary, 24 Front St., West Toronto, Canada.

Midwest Power Conference and Exhibition, at Chicago, Feb. 12-16; G. E. Pfisterer, secretary, 53 West Jackson Blvd., Chicago.

National Association of Power Engineers, annual convention at Detroit, Sept. 11-15, and concurrently National Exhibitors' Assn. exhibit; Fred Raven, 417 South Dearborn St., Chicago.

National Association Practical Refrigerating Engineers, annual convention at Louisville, Kentucky, Nov. 20-23; E. H. Fox, secretary, 5707 West Lake St., Chicago, Ill.

New York Power Show (National Exposition of Power and Mechanical Engineering) will be held at the Grand Central Palace, New York City, Dec. 3-8. Address inquiries to the International Exposition Company, Grand Central Palace, New York City.

New England Water Works Association, annual convention at Montreal, Canada, Sept. 18-21, Frank J. Gifford, secretary, 715 Tremont Temple, Boston, Mass.

Stoker Manufacturers Association, fall meeting at Greenbrier Hotel, White Sulphur Springs, W. Va., Oct. 22-24.

Second Bituminous Coal Conference will be held at Pittsburgh, Nov. 19-22.

World Power Fuel Conference at the Imperial Institute, London, Sept. 24 to Oct. 6.

Commission Plans for Growth of Power in Saskatchewan

With the rapid growth of the prairie provinces of Canada during the last few years, there has come an increased demand for electrical energy, and while Manitoba and Alberta have been the most active in this respect, Saskatchewan is also rapidly forging ahead. Last year the Saskatchewan government appointed a commission to report upon the economic practicability of generating power at a central steam-power plant and at water-power sites and distributing it throughout the province. This commission, under the chairmanship of L. A. Thornton, of Regina, carried on an active investigation.

A recent estimate by the water-power branch of the Dominion government gives the total available water-power resources of Saskatchewan as 542,000 hp. under conditions of ordinary minimum flow, or 1,082,000 hp. ordinarily available for six months of the year. While water-power development on an extensive scale appears to be the goal aimed at, steam generation is destined to play an important part in the economic development of the province for some time to come. The Mid-West Utilities Company, which is controlled by the International Utilities Corporation, is operating plants in various parts of the province, principally at Watrous, Rosetown, Kindersley and Lloydminster.

In a report just issued, the Saskatchewan Power Commission recommends the immediate purchase of the municipal plants at Regina, Moose Jaw and Saskatoon as the initial step in the development of a provincial power scheme. The commission proposes that Regina and Moose Jaw should be connected by a transmission line to form a southern system and that a northern system should be formed by linking Saskatoon, Prince Albert and the Battlefords. Immediate reconstruction of the Saskatoon plant at a cost of $1,500,000 is recommended, together with the purchase of the Prince Albert and north Battlefords plants.

Universal Craftsmen Hold Convention

Newark, New Jersey, was the scene last week of the Twenty-sixth Annual Convention of the Universal Craftsmen Council of Engineers. Meetings and social events were held in the new Elks Building and in the adjoining Industrial Building. There was an exhibit of the products of about seventy power plant equipment manufacturers.

Following an informal reception on Monday evening, the convention was officially opened on Tuesday morning with an address of welcome to the city by Commissioner John F. Murray, Jr., and by William T. Vanderlipp, Grand Master of the New Jersey Masons. Joseph Paton, chairman of the Convention Committee, also spoke, and William L. Mallon on behalf of the local chamber of commerce officiated at the opening of the exhibition.

Each morning, through Friday, was taken up with business sessions of the Council, and in the afternoons excursions were made to various points of interest and to nearby plants. These included a bus ride to Coney Island, and an inspection of the General Electric Lamp Works at Harrison, New Jersey. The convention concluded with a banquet in the Elks Lodge Room on Friday evening, at which the principal speaker was Howard R. Cruse, Junior Past Grand Master of Masons for the State of New Jersey.

Among the officers for the coming year are:

Grand Worthy Chief, John R. Hass, of Chicago; Grand Assistant Chief, George A. Lambert, of Brooklyn, N. Y.; Grand Secretary, Thomas H. Jones, Cherrydale, Pa.; Grand Treasurer, John L. O'Brien, Chicago.

PERSONALS

GRANT THORN recently resigned as sales manager of the American Cyanamid Company to become associated with the subsidiaries of International Combustion Engineering Corporation, New York, which are identified with the coal-tar products and allied chemical fields.

DEXTER S. KIMBALL, Dean of Cornell University, was elected president of the Society for the Promotion of Engineering Education at the recent annual meeting of the society held at Chapel Hill, North Carolina.

A. G. M MICHELL, inventor of the Michell thrust bearing, is in New York in the interests of his crankless engine.

PROF. F. C. FENTON, of the Agricultural Engineering Department of Iowa State College, Ames, Iowa, has been selected to succeed H. B. Walker as head of the Department of Agricultural Engineering at Kansas State Agricultural College, Manhattan. Professor Fenton has likewise been chosen to succeed Professor Walker as secretary, treasurer and state supervisor of the Kansas Committee on Relation of Electricity to Agriculture.

WARREN VIESSMAN has been appointed engineer in charge of the Bureau of Mechanical Electrical Service, Baltimore, Md., by Mayor William F. Broening, to fill the position formerly held by Charles F. Goob, who is now chief engineer of Baltimore.

PROF. FRANZ A. KARTAK, head of the Department of Electrical Engineering, Marquette University, Milwaukee, Wis., has been appointed dean of the College of Engineering of that institution. Professor Kartak, who will not take office until after the opening of the next semester, will succeed Dean Frank C. French, resigned.

BUSINESS NOTES

THE AMERICAN ELEVATOR & MACHINE CORPORATION announces the appointment of Claude Hartford, formerly manager commercial relations, New York Steam Corporation, as vice-president of the corporation, in charge of sales.

THE DISSOSWAY CHEMICAL COMPANY has closed its office at 55 Eckford Street, Brooklyn. All inquiries, correspondence, and orders should be addressed to the New York Office, Graybar Building, New York City.

MURRAY IRON WORKS COMPANY, Burlington, Iowa, has appointed Wyman-Keagy Company, 1101 Chamber of Commerce Building, Columbus, Ohio, as district turbine sales manager.

MR. OTTOMAR H. HENSCHEL, consulting engineer, announces that he is opening an additional office in Room 401 Commerce Building, Fourth and Wells Sts., Milwaukee, Wis. This is in addition to his present office at 50 Keese Ave., Milwaukee. Mr. Henschel would be pleased to receive catalogs and bulletins from manufacturers of power generation, transmission, distribution and utilization equipment.

M. B. SKINNER COMPANY, announces that after Aug. 15, its main office will be at its new plant, Sample and Falcon Sts., South Bend, Ind.

H. W. FULLER, vice-president in charge of engineering and construction, Byllesby Engineering & Management Corporation, has announced the appointment of W. G. Jens, formerly acting manager of the Pittsburgh branch, Byllesby Engineering & Management Corporation, as manager of the branch.

TRADE CATALOGS

RESISTANCE THERMOMETERS — The Brown Instrument Company, Philadelphia, Pa., has issued an attractive 56-page bulletin describing its complete line of resistance thermometers of the indicating, recording, signaling and automatic control types. Illustrations show various applications of these instruments and schematic diagrams of the Wheatstone bridge circuit, used in the instruments. Schematic connections of a four-record recorder, indicator with switch, bridge circuit box, standardizing panel and four resistance bulbs, are also included.

CARBIC LIGHT—The features of the Carbic acetylene light, which is made in a number of styles, are described in a little booklet issued by the Oxweld Acetylene Company, New York. This light was designed for general flood lighting to permit the accomplishment of night work and operations in dark places during the day.

PORTABLE OIL-TESTING SETS — A four-page bulletin of the General Electric Company, dealing with portable equipment for making tests on insulating oils. This bulletin contains valuable information on how to make these tests.

FEED-WATER REGULATOR—The operating characteristics and constructional details of the Copes feed-water regulator are clearly presented in a new bulletin just issued by the Northern Equipment Company, Erie, Pa. The various types of control valves used for the certain conditions, including the standard-port, V-port and compound-port and the B. I. A. control valve, in which the feed flow area can be changed while the boiler is under load, are clearly illustrated and described. Illustrations of typical installations on various types of boilers are also included.

COAL STORAGE EQUIPMENT—As the cost of handling coal is an important item in the operating charges of a power plant, the new bulletin entitled "Storage of Coal," issued by the Sauerman Bros., Inc., Chicago, Ill., will be of interest to engineers. The bulletin deals especially with the use of the drag scraper in the storing of coal and includes lay-out of typical scraper systems.

SMOOTH-ON HANDBOOK — The Smooth-On Manufacturing Company, 570 Communipaw Ave., Jersey City, has issued a little booklet entitled "Helpful Ideas for Engineers," containing brief abstracts from the 136-page Smooth-On Handbook. The material has been condensed and is presented in a way to make it valuable to any engineer.

ARC WELDING—In a 27-page illustrated bulletin, GEA-423A, the General Electric Company shows its use of arc welding in the manufacture of its various products. Illustrations of General Electric welding equipment are also included.

OHMMETER—The Roller-Smith Company, 233 Broadway, New York, has just issued a new bulletin No. 300, describing and illustrating three types of portable, direct-reading, slide-wire ohmmeters, designed with particular reference to speed and simplicity in operation. A description of a portable direct-reading circuit tester is also included.

FUEL PRICES

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except **Pittsburgh gas slack:**

Bituminous (Net Tons)	Market Quoting	Price per Ton
Navy Standard...	New York.....	$2.25@$2.60
Kanawha.....	Columbus.....	1.25@ 1.60
Smokeless.....	Cincinnati.....	2.00@ 2.25
Smokeless.....	Chicago.....	2.00@ 2.25
S. E. Kentucky...	Chicago.....	1.35@ 1.60
Steam.....	Pittsburgh.....	1.80@ 1.90
Gas Slack.....	Pittsburgh.....	1.20@ 1.30
Big Seam.....	Birmingham....	1.25@ 1.75
Anthracite (Gross Tons)		
Buckwheat.....	New York.....	$2.75@$3.00
Birdseye.....	New York.....	1.60

FUEL OIL

New York—Aug. 9, f.o.b. Bayonne, N. J.: 28@34 deg., Baumé, industrial use, tank-car lots, 4¾c. per gal.; 36@40 deg., furnace, tank-car lots, 7c. per gal.

St. Louis—Aug. 1, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.35 per bbl.; 26@28 deg., $1.40 per bbl.; 28@30 deg., $1.45 per bbl.; 30@32 deg., $1.50 per bbl.; 32@36 deg., gas oil, 4.151c. per gal.; 38@40 deg., 4.855c. per gal.

Pittsburgh—Aug. 1, f.o.b. local refinery, 30@34 deg., fuel oil, 5½c. per gal.; 36@40 deg., 5¾c. per gal.

Philadelphia—Aug. 2, 26@30 deg., $2.00@$2.07 per bbl.; 13@19 deg., $1.05 @$1.12 per bbl.; 22 plus, $1.48@$1.55 per bbl.; 27@30 deg., $2.10@$2.17 per bbl.

Cincinnati—July 31, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5c. per gal.; 26@30 deg., 5½c. per gal.; 30@32 deg., 5.95c. per gal.

Chicago—July 28, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl.: 22@26 deg., 57½@60c. per bbl.; 26@30 deg., 75c. per bbl.; 30@32 deg., 90c. per bbl.

Boston—Aug. 6, tank-car lots, f.o.b. 12@14 deg. Baumé, 4.35c. per gal.; 28@32 deg., 5.55c. per gal.

Dallas—Aug. 1, f.o.b. local refinery, 26@30 deg., $1.40 per bbl.

New Plant Construction

COMPILED BY THE MCGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Ala., Tuscaloosa—Gulf States Service Co. awarded contract for design, construction and equipment of power plant on the Black Warrior River to United Engineers & Constructors, Inc., Broad and Arch Sts., Philadelphia, Pa. The design calls for one 7,500 kw. steam turbine and three 1,000 hp. boilers. Boilers will burn pulverized coal. Estimated cost $1,000,000.

Ark., Hot Springs—New York Hotel Co., T. K. Martin, Secy., 118 Frances St., is having preliminary plans prepared for a 14 story hotel at Broadway and Spring St. Estimated cost $1,000,000. G. R. Mann, New Donaghey Bldg., Little Rock, is architect.

Conn., Hartford — Underwood - Elliott - Fisher Co., Capitol Ave., awarded contract for power plant to Aberthaw Constr. Co., 80 Federal St., Boston, Mass. Estimated cost $300,000.

D. C., Washington—U. S. Government will receive bids until Aug. 15 for conduit high tension system from Capitol power plant to Capitol buildings. D. Lynn, Capitol, is architect.

Ga., Cordele—Bd. of Crisp County Comrs., Cordele, awarded contracts for earth dam, 3,500 ft. long, 20 ft. high, concrete dam, 670 ft. long, 30 ft. high, 100 ft. wide at base, also construction of 150 x 40 ft. power house to L. E. Myers Constr. Co., 53 West Jackson Blvd., Chicago, Ill., and S. J. Groves & Son, Cordele, $776,837; hydraulic machinery and equipment to Newport News Shipbuilding & Dry Dock Co., Newport News, Va., $99,200; electrical machinery and equipment to General Electric Co., $102,500.

Ill., Chicago—University of Chicago, 189 West Madison St., having plans prepared for a power plant at 61st St. and Blackstone Ave. Estimated cost $1,500,000. Nieler, Rich & Co., 431 South Dearborn St., are engineers. P. B. Maher, 159 East Erie St., is architect.

Me., Burnham — Central Maine Power Co., Green St., Augusta, awarded contract for construction of a power plant here, to Ambursen Constr. Co., Grand Central Terminal Bldg., New York City. Total cost $300,000.

Mass., Salem—Owner c/o Funk & Wilcox, Engr., 26 Pemberton Sq., Boston; awarded contract for the construction of a 100 x 150 ft., ice manufacturing plant on Franklin St., to Pitman & Brown, 11 Washington St. Estimated cost $100,000.

Mich., Detroit — Detroit Biltmore Hotel Co., Hotel Tuller, awarded contract for the construction of a 35 story hotel, 18 story office and 600 car garage including steam heating system to Walbridge Aldinger Co., Penobscot Bldg., and Otto Misch Co., 159 E. Columbia Ave. Total estimated cost $25,000,000.

N. J., Beachhaven—Bd. of Council, Boro Hall, awarded contract for rebuilding electric light plant to B. L. Crammer. Estimated cost $40,000.

N. J., Hoboken—J. J. O'Leary, 730 Hudson St., plans the construction of an 8 story apartment building including steam heating system, etc., at Washington St. between 10th and 11th Sts. Estimated cost $500,000. Architect not selected.

N. Y., New York—Eighty Seven St. and East End Ave. Corp., 250 Park Ave., had plans prepared for a 14 story hospital at 545 East 87th St. Estimated cost $1,750,000. Crow, Lewis & Wick, 200 5th Ave., are architects.

O., Cincinnati—Christ Hospital, Auburn Ave., awarded contract for construction of a power plant to J. & F. Harig Co., Queen City Ave. Estimated cost $115,000.

O., Cleveland—Otis Steel Co., c/o J. D. Campbell, 3341 Jennings Rd., have completed plans for furnace building and boiler house. Estimated cost $50,000.

O., Delaware—Ohio Wesleyan University, is having preliminary plans prepared for a group of college buildings. Estimated cost $1,000,000. Walker & Weeks, 2341 Carnegie Ave., Cleveland, are architects.

O., Kent—Bd. Trustees, Kent State Normal School, W. A. Cluff, Chrm., will receive bids until Aug. 31 for remodeling power house, building 700 ft. tunnel to carry steam and electric lines, etc. Estimated cost $70,000. Ronan & Ingreson, 1694 High St., Columbus, is engineer.

O., Shelby — City plans additions to municipal light plant including new generator equipment. Estimated cost $50,000. Hadlow, Hughes, Hick & Conrad, Inc., Union Mortgage Bldg., Cleveland, are engineers.

Tenn., Cookeville — City, J. Whitson, Mayor, voted $100,000 bonds for hydro-electric dam for municipal electric light plant.

Tex., Dallas—W. S. Dunne, 301 Melba Bldg., Archt., will receive bids after Sept. 1 for a 12 story hotel at Main and Martin Sts. for C. A. Mangold and E. W. Morten, c/o Morten Investment Co. Estimated cost $750,000.

Tex., Port Arthur—McDaniel Bros., P. O. Box 826, Beaumont general contractors, taking sub bids for refrigerating and steam heating systems for proposed 10 story, hotel here, for H. Vaughn. Estimated cost $500,000.

Wash, Wenatchee—Wenatchee Cold Storage Corp., awarded contract for 4 and 5 sty. 168 x 270 ft., cold storage fruit sorting and grading plant to Welden Constr. Co., Seattle. $500,000.

Wis., Madison—Southern Wisconsin Produce Co., awarded contract for warehouse and poultry feeding station, loading platform and refrigeration plant to Krasin Bros., Marshfield. $37,995.

Ont., Leamington—H. J. Heinz Co., 1062 Progress St., Pittsburgh, Pa., awarded contract for boiler house to G. H. Emery, Dowler Bldg., Windsor; boiler stack to Custodis Canadian Chimney Co., 70 King St., W. Toronto.

Que., Three Rivers—Dominion Coal Co., Ltd., Glace Bay, N. S., plans construction of a new coal plant, electrically controlled, will consist of unloading and stocking bridge to work in conjunction with two steel towers and a conveyor. Storage space 200,000 tons coal.

Equipment Wanted

Boilers, Stokers, Etc.—Bd. Trustees State Normal School, Kent, O., will receive bids until Aug. 31, two 250 hp. boilers, two stokers, and other equipment for proposed power house. Ronan & Ingreson, 1694 N. High St., Columbus is engineer.

Pump—Rosemount, Minn., J. J. McLafferty, clk., will receive bids until Aug. 17, furnishing and installing deep well pump, also construction of pump house.

Pumps—Centralia, Kan., W. R. Wolff, clk., will receive bids until Aug. 16, one 60 g.p.m., motor driven pump in connection with proposed water works improvements.

Pumping Equipment—Big Springs, Tex., M. Montin, City Mgr., bond election soon for pumping equipment for extension of water distribution system. Estimated cost $35,000.

Pumping Plant—Madison, S. D., C. A. Trimmer, City Engr., will receive bids until Aug. 17, for pumping plant, two motor driven centrifugal pumps, 500 g.p.m. each, in connection with proposed water works improvements.

Refrigerating Equipment — Bureau of Yards and Docks, Navy Dept., Washington, D. C., will receive bids until Aug. 22, for refrigerating equipment for Naval Air Station, Pensacola, Fla.

Steam Engine Repairs—Bureau of Yards and Docks, Navy Dept., Washington, D. C., will receive bids until Aug. 22, for repairs to steam engine, Brooklyn, N. Y. Navy Yard.

Stokers and Forced Draft Equipment—City of Cleveland, O., will receive bids until Aug. 17, for stokers and forced draft equipment, also laundry machinery.

Industrial Projects

Calif., Sacramento—Paper Mill, Printing Plant, etc.—Zellerbach Paper Co., 1215 Front St., having plans prepared for a 3 story, paper mill, printing plant and warehouse. Estimated cost $175,000. Architect not announced.

Calif., El Monte—Creamery—Los Angeles Creamery Co., Los Angeles, awarded contract for 2 story, 98 x 132 ft., creamery, including separate building for ice tanks, etc., to Carr & Bennett, c/o Los Angeles Creamery, El Monte, $100,000.

Ind., Indianapolis — Foundry Addition—Federal Foundry Co., awarded contract for additions to include brass foundry, carpenter shop, core room and sand bin additions, pattern shop, etc., to James and Shafer Co., Smythe Bldg., Cleveland, O.

Iowa, Des Moines—Casket Factory—Des Moines Casket Co., 405 Southwest 8th St., awarded contract for 100 x 135 ft. casket factory to Garmer & Stiles, 519 14th St. Estimated cost $40,000.

Minn., Duluth—Electric Repair Shops, Etc.—Minnesota Power & Light Co., 30 West Superior St., awarded contract for shops for repair of electric machinery, also storehouse to Pfeffer Constr. Co. Builders Exch. Estimated cost $80,000.

Mo., St. Louis—Foundry—Century Electric Co., Inc., 1806 Pine St., E. S. Pillsbury, pres., 262 x 242 ft., will build on subcontract basis and with own forces, 262 x 242 ft. foundry. Estimated cost $200,000. Klipstein & Rathman, 316 North 8th St., is engineer.

N. Y., Albany—Packing Plant Additions—Albany Packing Co., awarded contract to John B. Pike & Son Inc., Rochester, for addition to packing plant. Estimated cost $300,000.

N. Y., New York—Candy and Ice Cream Plant, W. J. Carlin, 234 W. 78th St., plans the construction of a 3 story, 25 x 86 ft., candy and ice cream plant. G. F. Mitchell, 959 Madison Ave., archt. Estimated cost $40,000.

N. Y., Olean—Tile Plant—Olean Tile Co. awarded contract for construction of 3 buildings, 161 x 260 ft.; 90 x 105 ft.; 50 x 362 ft., to A. A. Lane construction Co., 1869 E. 55th St., Cleveland, O.

N. C., Greensboro—Silk Throwing Mill—M. & S. Grobart, Paterson, N. J., having plans prepared for the construction of a silk throwing mill at Oakland Ave. and Bruce Sts. Estimated cost $140,000. H. Barton, Greensboro, is architect.

N. C., Lexington—Gas Plant—Lexington Thomasville Gas Co., N. H. Gellert, Pres., awarded contract for construction of an artificial gas plant to Atlantic Constr. & Engineering Co., Phila., Pa. Estimated cost $175,000.

O., Ashtabula — Rubber Factory and Machine Shop—Aetna Rubber Co., H. J. Kappler, Vice-Pres. and Genl. Mgr., 815 East 79th St., Cleveland, awarded contract for 60 x 100 ft. factory and 50 x 113 ft. machine shop to Webster Constr. Co., Ashtabula. Estimated cost $125,000.

O., Cleveland—Screw Factory — Triplex Screw Co., A. F. Weber, Mgr., 6112 Central Ave., awarded contract for 40 x 120 ft., factory to J. L. Hunting Co., Guarantee Title Bldg. Estimated cost $40,000.

Tex., Atreco—(Mail Port Arthur)—Oil Refinery—Atlantic Refinery Co., 260 S. Broad St., Philadelphia, Pa., plans construction of an oil refinery here. New machinery and equipment will be required. Estimated cost $500,000.

Ont., Petrolea—Beet Sugar Refinery—Superior Sugars Ltd., plans to take over premises and equip a plant, capacity 800 ton beets per day. F. G. Potter, Engr., c/o owner, will purchase all equipment.

PRICES - MATERIALS - SUPPLIES

Electrical prices on following page are to the power plant by jobbers in the larger buying centers east of the Mississippi. Elsewhere the prices will be modified by increased freight charges and by local conditions.

SINCE LAST MONTH

THE declining tendency noted in power-plant materials and supplies throughout July, is still in evidence. Compared with last month's levels, prices are lower for hose, belting, linseed oil, and flexible cord. Practically the only advance to occur in prices of materials listed here, was a rise of 1¼c. per lb. in highest grade babbitt metal at New York.

POWER-PLANT SUPPLIES

HOSE—Quotations at New York warehouses:

	Fire Protection	50-Ft. Lengths
Underwriters' 2½-in., coupled, single jacket		(net) 60c. per ft.
Common, 2½-in., cotton, rubber-lined	80c. per ft. list, less	50%

Air—Best grade

¾-in., per ft.	3-ply $0.30	4 ply	$0.36

Steam—Discounts from List

First grade 40%	Second grade 45%	Third grade	50–10%

RUBBER BELTING—List price 6-in., 6 ply, $1.83 per lin.ft. The following discounts from list apply to rubber transmission belting:

Best grade	50%	Second grade	60%

LEATHER BELTING—List price, 24c., per lin.ft. per inch of width, for single ply, at New York warehouses:

Grade	Discount from list
Medium	30–10%
Heavy	25–5%

RAWHIDE LACING—For cut, best grade, 30–10%; 2nd grade, 50–10%. For laces in sides, best, 55c. per sq.ft.; 2nd, 50c. Semi-tanned, cut, 30–10%.

PACKING—Prices per pound at New York warehouses:

Rubber and duck for low-pressure steam, ¼ in.	$0.90
Asbestos for high-pressure steam, ¼ in.	1.75
Duck and rubber for piston packing	.90
Flax, regular	1.15
Flax, waterproofed	1.70
Compressed asbestos sheet	.85
Wire insertion asbestos sheet	1.20
Rubber sheet	.45
Rubber sheet, wire insertion	.75
Rubber sheet, duck insertion	.55
Asbestos packing, twisted or braided and graphited, for valve stems and stuffing boxes	1.40
Asbestos wick, ½- and 1-lb. balls	.50

PIPE AND BOILER COVERING—Discounts, New York warehouses, are as follows:

85% magnesia, high pressure		50%
Asbestos, air cell, for low-pressure heating and return lines	4-ply	70%
	3-ply	72%
	2-ply	74%

PORTLAND CEMENT—New York, $2.25@$2.35 per bbl. without bags, delivered by truck to site of job. Bag charge, 40c. per bbl.

STRUCTURAL STEEL—New York delivered price, beams and channels, 3 to 15-in.; angles, 3 to 6-in., ¼-in. thick; tees, 3-in. and larger; and plates, ¼-in. thick and heavier; all $3.30 per 100 lb. in lots of 250 to 3,999 lb.

COTTON WASTE—The following prices are in cents per lb., at warehouse:

	New York	Cleveland	Chicago
White	10.00@13.50	16.00	15.00
Colored	9.00@13.00	12.00	12.00

WIPING CLOTHS—Prices per pound in lots of about 600 lb., for washed, white wipers, as follows:

Chicago	$0.17
New York	.15½
Cleveland (*per thousand*)	38.00

LINSEED OIL—These prices are for raw oil in barrels, f.o.b., in 1 to 4 bbl. lots:

	New York	Cleveland	Chicago
Per pound	$0.107	$0.105	$0.107

WHITE AND RED LEAD—Per 100-lb. keg, base price, f.o.b. New York:

	Dry	In Oil
Red	$13.25	$14.75
White	13.25	13.25

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

Tank rivets, small, including ⅝-in. dia., list (Apr. 1, 1927) less 50-10% in full packages, for immediate delivery from warehouse stocks in New York and vicinity.

Structural rivets, ½-in., per 100 lb.:
New York $5.00* Chicago $3.60 Pittsburgh mill $2.90

Cone-head boiler rivets, ½-in., per 100 lb.:
New York $5.00* Chicago $3.60 Pittsburgh mill $2.90

*Price is for full packages; broken package lots, $6.50 net, delivered.

REFRACTORIES—Prices in car-loads, f.o.b. plant:

Chrome brick, eastern shipping points	per net ton	$45.00
Chrome cement, 40@50% Cr_2O_3, in bulk	per net ton	22@25
Chrome cement, 40@50% Cr_2O_3, in sacks	per net ton	26@29
Magnesite brick, 9-in. straights	per net ton	65.00
Magnesite brick, 9-in. arches, wedges and keys	per net ton	71.50
Magnesite brick, soaps and splits	per net ton	91.00
Silica brick, Mt. Union, Pa.	per M	43.00
Clay brick, 1st quality, 9 in. shapes, Pennsylvania	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Ohio	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Kentucky	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Maryland	per M	43@46
Clay brick, 2nd quality, 9 in. shapes, Pennsylvania	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Ohio	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Kentucky	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Maryland	per M	35@38
Chrome ore crude, 40@50%	per net ton	18.00@22.50

BABBITT METAL—Delivered, New York, cents per lb.:

Genuine, highest grade	67.75
Commercial genuine, intermediate grade	53.00
Anti-friction metal, general service	31.50
No. 4 babbitt (f.o.b.)	12.25

COLD DRAWN STEEL—Shafting and screw stock, warehouse prices per 100 lb., base, are as follows:

	New York	Cleveland	Chicago
Round or hexagon	$3.40	$3.65	$3.60
Flat or square	3.90	4.15	4.10

BOILER FITTINGS—F. o. b. New York or Jersey City, discounts from list:

	Current
Copper ferrules	70%
Boiler flanges	65-5%
Boiler stay bolts	60%
Boiler patch bolts	20%
Boiler fitting-up bolts	45%
Pressed steel boiler lugs	10%

WROUGHT PIPE—The following discounts from list are for large mill lots at Pittsburgh mill:

BUTT WELD

Steel Inches	Black	Galv.	Iron Inches	Black	Galv.
1 to 3	62	50½	1 to 1½	30	13

LAP WELD

2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60	49½	1 to 1½	30	14
2 and 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

BOILER TUBES—Following are net prices per 100 ft. at New York warehouses on tubes manufactured according to specifications of the American Society of Mechanical Engineers:

Size	Lapweld Steel	C. C. Iron	Seamless Steel
1	.....	.....	$17.07
1¼	.....	.....	19.20
1½	.....	$38.00	17.92
1¾	.....	28.50	20.48
2	$17.33	25.00	20.24
2¼	19.84	28.25	23.00
2½	21.60	34.00	26.03
3	25.50	42.50	27.04
3¼	30.25	49.50	30.67
3½	31.50	52.75	33.33
4	38.03	67.00	40.11

Tubes 2½ in. diameter, or smaller, over 18 ft. long, 10 per cent extra.

These prices are net, per 100 ft., based on stock lengths. If cut to special engths, billing will be based on the entire stock lengths.

In addition to the above, standard cutting charges are as follows:

2 in. and smaller.. 5c. per cut. 3 in..... 9c. per cut.
2¼ and 2½ in..... 6c. per cut. 3½ to 4 in.... 10c. per cut.

ELECTRICAL SUPPLIES

ARMORED CABLE—Price per 1,000 ft.—5 per cent. 10 days.

B. & S. Size	Two Cond. M Ft.	Three Cond. M Ft.	Two Cond. Lead M Ft.	Three Cond. Lead M Ft.
No. 14 solid	$30.00 (net)	$44.00 (net)	$180.00	$220.00
No. 12 solid	136.00	180.00	225.00	275.00
No. 10 solid	185.00	235.00	275.00	325.00
No. 8 stranded	305.00	375.00	420.00	500.00
No. 6 stranded	440.00	530.00	615.00	.....

From the above lists discounts are:		Lead Covered
Less than coil lots	50%	30%
Coils to 1,000 ft	60%	35%
1,000 to 5,000 ft	65%	38%
5,000 ft. and over	67%	40%

CONDUIT—Price per 1,000 ft.; **ELBOWS AND COUPLINGS**, per 100 pieces, extra f.o.b. New York warehouse. Discount of 5 per cent. for payment in 10 days. Delivery charges, approximately 4 per cent. additional.

Size In.	Conduit Black Per M	Conduit Galvanized Per M	Elbows Black Per C	Elbows Galvanized Per C	Couplings Black Per C	Couplings Galvanized Per C
¼	$56.50	$61.34	$7.76	$8.83	$4.52	$4.92
⅜	72.07	78.63	10.21	11.63	6.46	7.03
½	103.31	113.00	15.10	17.21	8.39	9.13
¾	139.77	152.88	20.51	23.07	11.78	12.75
1	167.12	182.79	27.34	30.76	14.56	15.75
1¼	224.85	245.94	50.13	56.40	19.41	21.01
1½	355.50	388.85	82.03	92.28	27.73	30.01
2	464.88	508.50	218.74	246.10	41.59	45.01
2½	585.30	637.74	483.04	543.46	55.46	60.02
3	714.17	776.30	558.23	628.06	69.32	75.02

CONDUIT BODIES AND FITTINGS—Black or galvanized.

	Less than $10 list	$10 list to $100	$100 list and over
Standard package	10%	20%	28%
Less than standard package	5%	10%	20%

CUT-OUTS—Following are net prices, each, in standard-package quantities:

CUT-OUTS, PLUG, SOLID, NEUTRAL OR 2-FUSE

S. P. M. L.	$0.12	D. P. D. B.	$0.31
D. P. M. L.	.16	T. P. S. B.	.35
T. P. M. L.	.27	T. P. D. B.	.47
D. P. S. B.	.16		

CUT-OUTS, N. E. C. FUSE, SOLID, NEUTRAL OR 2-FUSE

	0-30 Amp.	31-60 Amp.	60-100 Amp.
D. P. M. L.	$0.27	$0.70	$1.75
T. P. M. L.	.40	1.00	2.30
D. P. S. B.	.35	.87	.....
T. P. S. B.	.67	1.50	.....
D. P. D. B.	.65	1.75	..
T. P. D. B.	1.12	3.00	.....
T. P. to D. P. D. B.	.75	2.10	.. ..

FLEXIBLE CORD—Price per 1,000 ft. in coils of 250 ft.:

No. 18 cotton reinforced heavy	$16.50
No. 16 cotton reinforced heavy	20.00
No. 18 cotton reinforced light	13.00
No. 16 cotton reinforced light	17.60
No. 18 cotton Canvasite cord	14.60
No. 16 cotton Canvasite cord	16.90
No. 16 super service cord or similar (2 wire) in 1,000 ft.	$72.00 *80.00
No. 14 super service cord or similar (2 wire) in 1,000 ft.	110.00 *122.00

*Less than 1,000 ft.

NATIONAL ELECTRIC CODE FUSES, NON-REFILLABLE—

250-Volt	Std. Pkg.	List	600-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.15	3-amp. to 30-amp.	100	$0.30
35-amp. to 60-amp.	100	.30	35-amp. to 60-amp.	100	.60
61-amp. to 100 amp.	50	.90	65-amp. to 100-amp.	50	1.50
101-amp. to 200-amp.	25	2.00	110-amp. to 200-amp.	25	2.50
201-amp. to 400-amp.	25	3.60	225-amp. to 400-amp.	25	5.50
401-amp. to 600-amp.	10	5.50	450-amp. to 600-amp.	10	8.00

Discount: Less than one-fifth standard package, 60%; one-fifth to standard package, 64%; standard package, 70%.

RENEWABLE FUSES—List price each:

Sizes	250-Volt List-Price	600-Volt List-Price	Std. Pkg. Quantity	Carton Quantity
1 to 30-amp.	$0.50	$1.10	100	10
35 to 60-amp.	1.00	1.25	100	10
65 to 100-amp.	2.00	3.00	50	5
110 to 200-amp.	4.00	5.00	25	5
225 to 400-amp.	7.50	11.00	25	1
450 to 600-amp.	11.00	16.00	10	1

REFILLS—

1 to 30-amp	$0.03 ea.	$0.05	100	100
35 to 60-amp.	.05 ea.	.06	100	100
65 to 100-amp.	.10 ea.	.10	50	50
110 to 200-amp	.15 ea.	.15	25	50
225 to 400-amp	.30 ea.	.30	25	25
450 to 600-amp.	.60 ea.	.60	10	10

Discount Without Contract—Fuses:	
Broken carton	5%
Unbroken carton but less than standard package	22%
Standard package	40%
Discount Without Contract—Renewals:	
Less than standard package	Net list
Standard package	40%
Discount With Contract—Fuses:	
Broken cartons	10%
Unbroken cartons but less than standard package	26%
Standard package	42%
Discount With Contract—Renewals:	
Less than standard package	Net list
Standard package	42%

FUSE PLUGS, MICA CAP—

0-30 ampere, standard package (500)	$2.50
0-30 ampere, less than standard package	2.80

LAMPS—Below are present quotations in less than standard package quantities on Mazda standard, A type bulbs:

100—130 Volt Watts	General Type	Price Each	200—260 Volt Watts	Special Type	Price Each
15	A 17	$0.20	25	A 19	$0.25
25	A 19	.20	50	A 21	.25
40	A 21	.20	100	A 23	.45
50	A 21	.22	....	....	....
60	A 21	.22	....	....	....
100	A 23	.35	....	....	....

Standard pkg. quantities are subject to discount of 10% from list. Annual contracts ranging from $75 to $300,000 net, allow a discount of 15 to 40% from list.

PLUGS, ATTACHMENT—

	Each
Porcelain, separable, attachment plug	$0.18
Composition, 2-piece, attachment plug	.27
Swivel attachment plug	.12
Small size, 2-piece plug, composition	.07

RUBBER-COVERED COPPER WIRE—Per 1000 ft. f. o. b. New York:

No.	Solid Single Braid	Solid Double Braid	Stranded, Double Braid	Solid Duplex
14	$5.75	$8.00	$9.75	$16.00
12	8.80	10.20	12.10	22.00
10	11.90	14.00	16.00	28.90
8	17.50	19.20	20.15	39.50
6	.....	.....	30.00	.....
4	.....	.....	42.00	.....
2	.....	.....	60.00	.....
1	.....	.....	82.00	.....
0	.....	.....	101.00	.....
00	.....	.....	119.00	.....
000	.....	.....	142.00	.....
0000	.....	.....	172.00	....

SOCKETS, BRASS SHELL—Price each, net:

	½ In. or Pendant Cap Key	½ In. or Pendant Cap Keyless	½ In. or Pendant Cap Pull	¾ In. Cap Key	¾ In. Cap Keyless	¾ In. Cap Pull
Standard package	$0.12	$0.10	$0.16	$0.16½	$0.14	$0.20
Unbroken carton	.14	.12	.18	.18	.16	.21
Broken carton	.16	.14	.20	.20	.18	.24

WIRING SUPPLIES—

Friction tape, ¾ in., less than 100 lb., 31c. per lb.	100 lb. lots.... 29c. per lb.
Rubber tape, ¾ in., less than 100 lb., 33c. per lb.	100 lb. lots.... 31c. per lb.
Wire solder, less than 100 lb., 33c. per lb.	100 lb. lots.... 31c. per lb.
Soldering paste, 2 oz. cans	$1.00 doz.

ENCLOSED SWITCHES, KNIFE—Safety type, externally operated, 250 d.c or a.c., N.E.C.

TYPE "C" FUSED BOTTOM

Size, Amp.	Double Pole, Each	Three Pole, Each	Four Pole Each
30	$4.50	$6.00	$7.25
60	7.50	8.25	10.50
100	10.50	13.00	22.50
200	16.00	20.00	36.00

Discounts:	
Less than $25.00 list value	30%
$25.00 to $50.00 list value	30-5%
$50.00 list value or over	35%